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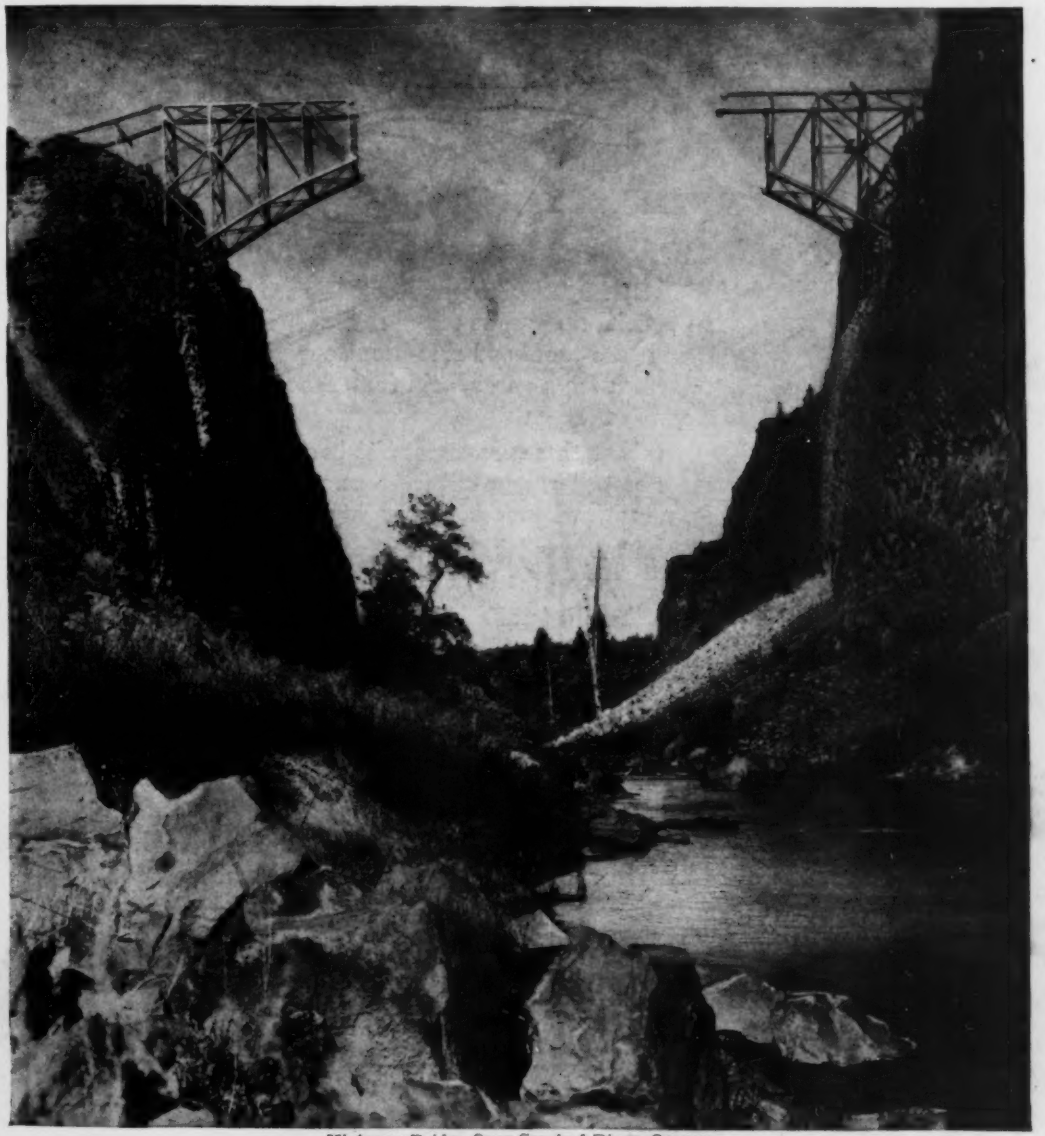

Highway Bridge Over Crooked River, Oregon

Building Alteration Involving 26-Story Self-sustaining Wall

What Should Be the Hauling Cost on Concrete Paving?

Pneumatic Filter-Alum Conveyor for Minneapolis

Oregon Steel Arch Bridge Erected by Cableway

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FRANK C. WIGHT
Editor

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Selling Highway Safety

EFFECTS of the recent Hoover conference on street and highway safety are beginning to show most in the speeches of the apostles who went forth from the Washington meeting. From all parts of the country there come reports of meetings, some called by the local traffic association activated by the national movement and some the regular meetings of societies and clubs, but all having in common an address or an exhortation by one who was at the Washington conference. Interest in better traffic control is thus being stimulated and because of the well balanced treatment of the subject by the national committees, the whole story of traffic control necessities is being gotten across to the people as never before. Engineers who were at Washington and who helped prepare the engineering sections of the several committee reports had some misgivings as to the permanence of their work, because of the very obvious magnification of the problems of registration and insurance in the main meetings. But these numerous local meetings and speeches now being reported show that the importance of the engineering phases of traffic control were not lost on the delegates. Secretary Hoover showed his usual keen sense of how to sell an idea when he initiated and fostered the Washington highway safety meetings.

Statistics or Experience

STATISTICS are for the general, not for the particular. To the unfortunate few who were killed at San Juan blockhouse that little skirmish in a little war was as important a battle as the struggle for the Argonne. The one man who is knocked down this week by an automobile in your village gets little satisfaction out of the fact that it leads the state in the safety of its streets. We must read our statistics with full appreciation of their applicability. Just now there seems to be some question among certain despondents as to the truth of the high construction volume figures that this journal and other agencies are reporting. There are contractors who tell us that they do not see much work in progress, and there are equipment and material men who want to know where all the business is that we report. The only answer is that these are the figures. Construction volume, based on the most reliable of reporting, continues high, not astoundingly high nor on a rising curve, but still as high or higher in all localities and in most varieties of construction as last year. Statistics of consumption, where they can be compiled, confirm the other figures. Construction continues to keep up. How long it will do so no one can tell, for in spite of some of our latter-day economists prediction is not yet completely the handmaiden of experience, but it is a fact that the occasional observation of a letting down in construction remains the individual observation and not the statistical sum of many recorded facts. It was the expectation of this journal the first of the year that midsummer would see some letdown to the rising demand for construction. There is still no reason to change that view, but so far there has appeared nothing which would require a moving forward of that predicted change.

To Take Up Construction Slack

CONSTRUCTION volume in the United States has so consistently increased year by year since the post-war depression that the possibilities of there ever being a slump seem very remote. It is just as well, therefore, to remember that all business has its ups and downs and that possibly the demand for new construction will sometime slacken and that when it does it will be a good thing to have an anchor to windward. Something like this was evidently in Senator Couzens' mind when he introduced the following amendment to the current public buildings bill: "The Secretary of the Treasury shall take into consideration the effect which may be exerted by governmental construction policy upon general employment and industrial activity and shall report to Congress with recommendations whenever the volume of construction in the United States during any period falls one-third below the volume of the corresponding period of 1925." Right after the war the possibility of taking up the slack in construction with public work was suggested but never had to be called into use. It is very much worth while to have this statistical survey available so that the government will at least know when the time has arrived to attempt this experiment in restoring economic balance.

Congressional Insufficiency

IN one of his speeches a short time ago the President cited the bungling and the hesitancy with which Congress has handled Muscle Shoals as an illuminative example of the inability of government to conduct business. Recent procedure in this celebrated power plant only adds to this observation. The wheels on the Tennessee are turning, power is being generated, the huge engineering project is completed, or at least its initial stage is completed. But Congress still haggles and hesitates. Five hundred odd men, all furtively looking for the political nigger in the woodpile, are milling around trying to find what in England is now called the "formula" whereby they cannot necessarily turn this white elephant to most efficient work but stable him where his presence will best benefit the interests that seem to control the most votes. The electrical power companies in the south have most inconsiderately put forward the bid that brings in the greatest return to

the people, who paid for the plant, but generating power is a prosaic business which has been known to be profitable, and neither the producers or the users of electric power have organized vote controlling bodies. So now some way out of accepting the power companies' offer must be found that will have in it somewhere a sounding appeal to the farmer, whether by it or not the farmer really benefits. Congress has its uses—but it makes a mighty poor board of directors for a business enterprise.

Better Building Inspection

HOW to protect against unsafe building has been a problem since ancient times. It is still with us, and in fact is a growing problem. There has been a great improvement of building practice, it is true, especially in the last four or five decades, and present-day building methods are unquestionably on a high plane; yet the increased complexity of the art has made the situation more difficult in greater ratio, and building offers more opportunity for error, misunderstanding, and ignorance today than in the past. It is therefore quite as important now as it was in the times of early history to devise means for making buildings wholly safe. We still have the problem to solve.

Whether severe penal laws such as those of Hammurabi were effective means of eliminating unsafe building even in his time is open to doubt. At all events modern tastes do not favor this system for application now. Many attempts to prosecute architects or builders whose work was involved in an accident have been unsuccessful. It is difficult to prove specific neglect or wilfully bad work, and judges and juries seem to demand such proof. The matter is made still more difficult by the fact that often the nature and cause of the accident cannot be determined unequivocally. And even more often, it cannot be determined just who was responsible for the particular item of work involved. Modern building work is highly complex in its organization, and half a dozen men may be responsibly related to the single detail which failed. Accident litigation merely reflects the fact that the organization of building work often permits the necessary branching and subdivision of responsibility to result in a total dispersion and loss of responsibility, and that in the extreme case a building goes together and hangs together by good luck rather than by singlecentered knowledge and purpose.

We depend today on elaborate systems of governmental building inspection to guard public safety in relation to building work. Much money and much conscientious effort are applied to this form of supervision. Yet it is generally admitted to fall far short of proper efficiency; it may eliminate some bad building, but it does not eliminate all. Officials charged with public building inspection readily admit this. Papers and discussions at the annual meetings of the Building Officials Conference deal extensively with the unsatisfactory results of the superficial plan examination and inadequate field supervision which municipal building departments carry out. One trouble—but only one—is that the size of building departments is quite inadequate for thoroughgoing building control. Complete plan examination and thorough field supervision would cost many times the available funds. Building permit fees provide only a fraction of the cost of a proper building control service, and it is unlikely that much larger fees can be obtained.

Two courses are open for improving these conditions, without resorting to repressive legislation on the ancient model or, on the other hand, to complete abandonment of building control. The one course is more complete dependence on the municipal building department. This means, for effective results, a very great increase of working force and cost, both in plan examination and in field inspection. The other course, aimed in quite different direction, is to make definite the uncertain and distributed responsibility for the conduct of the building operations, and center it in a single individual skilled in the problems of building construction and able to deal with them.

The first-mentioned line of effort has been advocated many times in different forms. One of its most interesting applications is found in a proposal for owner-paid building inspection. It has been made before this, we believe, but was advanced anew and with excellent argument at the Columbus meeting of the Building Officials Conference two weeks ago by E. C. Kerth, former building commissioner of Evansville, Ind. Field inspection is admittedly the weakest part of public building control. To improve this inspection, it is proposed that the owner who is having a building erected shall be required to employ throughout the work an inspector responsible to the municipal building department but paid by the owner. Apparently the building department would have to maintain a list of officially recognized inspectors in order to permit this system to be applied, from which list the owner would select and engage an inspector—or perhaps the building department would assign one.

To all intents and purposes, the system amounts to increasing the building permit fee sufficiently to provide complete field inspection. On the other hand, it is obvious that the inspector becomes the responsible authority on the building operation, and yet is essentially a negative element, authorized to veto rather than to give orders. It is not easy to see how such a plan would work out in detail, but there can be little question that in proportion as responsibility for the safety of the work is transferred to the building inspector—and his functions would necessarily entail an extensive responsibility—the men actually in charge of the building operations would be freed of responsibility.

The other course is represented most prominently by the proposal advocated by the Joint Committee on Structural Safety, a body representing architectural and engineering societies of the New York region and active on this subject during the last two or three years. This committee proposes to place entire responsibility for a building operation in a technically competent man, an architect or a structural engineer, and to give him full authority over the conduct of the work. Preferably the architect or engineer who designs the structure would also direct its construction—precisely as is done in the erection of a dam or power house, or the construction of a railroad. However, provision is made for a change in the architect or engineer, just as the chief engineer of any construction operation might be changed during the progress of the work, in which case

the full responsibility for the work would necessarily transfer itself to the new incumbent and he would have to satisfy himself of the adequacy of the entire work before going very far in carrying it out.

Interesting similarities and contrasts may be found in these two proposals. Their outstanding feature is that they are alike in calling for much greater effort in field supervision than is now generally provided. The one utilizes an established professional class, already defined in most states by law and everywhere by practice and public recognition, while the other proposes to utilize a newly established class of municipal employees. This difference, while significant, is however exceeded in importance by the fact that in the one, responsibility and directive authority are united while in the other they are separated and in addition responsibility is split up even more than now.

Whatever is finally done to organize for better building, the success of the system will depend, initially at least, on the degree to which the owner's interest is actively enlisted. That he has a major interest is clear, we think, and could readily be made a matter of proof, though this has not yet been done. The public interest, however, is the element of controlling importance. With the growing complexity and difficulty of building problems, already mentioned, the public safety element steadily increases in weight. It will compel action in the early future.

The Result of "Muddling Through"

IT IS said that during the World War a leading British prelate was asked which side was going to win. "Who won the San Francisco earthquake?" was the reply. The same answer might well be applied to the great general strike in England. Conjectures as to which side will win are futile, for whatever the immediate outcome the aftermath of the strike will be disastrous. Nothing good can come out of it, except such deductions as may in time reform the world, or at least England. For there can be little doubt that the strike marks the end of an era and that in the long perspective of history it will stand forth a peak-like eminence where kings and battles and wars are but rolling hills.

Whether or not the strike is a revolution or merely an economic crisis is of no importance. Too much discredit attaches to the ordinary use of the word "revolution." Surely the American nation, remembering its origin, need not deride the term. There can be such a thing as a necessary revolution: *vide* the Declaration of Independence. But a revolution to be justified must get somewhere if it is successful and the general strike has no such possibilities. If the government wins there will be left in the ranks of labor nothing but soreness and resentment, the storing up of wrath to come, a strengthening and solidarity of class feeling. If labor wins democratic government in England will be abandoned and the ballot box will disappear in the face of class forces. Whatever the labor leaders choose to call the strike, England today is faced with revolution, and with a revolution that holds forth as a beneficial result only the possibility of the complete reform of its industrial philosophy.

There is no one cause of the present crisis. England has not the fortunate position of the United States in economic development. The war hurt her in a hundred ways. She is a small country terribly crowded, importing four-fifths of her requirements and striving to compete industrially against a world that is rapidly learning the lesson she taught that to be the world's workshop has been better than to be the world's granary. But she did not take to heart the lesson this country learned after the war; that individual industrial initiative is better than government aid, that mechanization and more mechanization must supplant the hand of man and that group prosperity can only be built up by individual maximum effort. Her industrial leaders lack leadership and her labor rank and file are afflicted with the heresy that the less they work the more they will profit. For years she has been successful in her overpraised facility in "muddling through." The general strike is the climactic indication that she has come to the end of this particular road.

The coal strike, which precipitated the crisis, is merely an incident, but it is a significant one because it carries all the germs of the industrial disease. There are too many mines, and too few of them are properly mechanized, there are too many miners and the world market for coal, into which England must go and which makes her coal price, is increasingly competitive not only because of the growing use of other fuels but because of the greater productivity of the foreign mines. How to solve the difficulty would come with bad grace from any American who has studied our own coal muddle. But the fact remains that England has taken no constructive step towards its solution but has resorted to doles and subsidies which could but put off the evil day. The owners, resolute to maintain the artificially-inflated valuation of coal property —a disposition not confined to British capital—have refused to give way an iota. Labor, already at starvation wages, refused to go lower. The government had nothing to propose. Hence the impasse, which in time would have occurred from some other cause. Coal is only a symptom; the disease lies deeper.

A nation cannot be reborn overnight. There can be no hope that the settlement of the strike, which as this is written seems imminent, will bring immediate resolution of the social and economic forces into a forward moving resultant. The trouble is too deep seated and the complication too great. Indeed this depth and this complication are what make so depressing the contemplation of the future. But England has survived other crises and has worked her way upward in spite of them. It may be that this one is just what is needed to bring together her opposing thinkers, to encourage the spirit of compromise and to discourage the too-prevalent spirit of evasion. Modernization of her great plant is demanded, production in her industry must be stimulated, profits from her vested interests must be reduced. Her workmen must work harder and her industrialists think harder than they ever have before. It is easy in the security and prosperity of this favored nation to sit back and see faults and offer advice. No American commenting on the English strike can escape a charge of superciliousness; but the facts are self-evident, whatever be the cause. England must stop "muddling through."

Oregon Steel Arch Bridge Erected By Cableway

Highway Crossing Constructed Over Crooked River Canyon Near Railway Arch—Conditions of Site—Methods of Reducing Erection Stresses

By C. B. McCullough
Bridge Engineer, State Highway Department, Salem, Ore.

A STEEL arch highway bridge now being built over Crooked River canyon, in Jefferson County, Oregon, will be one of the highest highway bridges in the United States. It consists of a main steel arch span 330 ft. 8 in. c. to c. of end shoes, flanked on one end by 40 ft. and on the other end by 136 ft. of reinforced-concrete approach. The use of a "high line" cableway for handling the steel in erection adds to its technical interest.

Conditions of Site—At the point of crossing, Crooked River runs in a narrow box canyon with nearly perpendicular walls about 340 ft. apart and 300 ft. high. Three distinct types of basaltic formation occur in the walls: (1) At the top a heavily fissured basalt 70 to 80 ft. thick; next (2) about 110 ft. of a formation popularly known as dice rock, consisting of a closely fissured or finely grained basalt, rather more resistant to weathering than the upper section; and (3) columnar basalt from the bottom of the dice rock to the talus slope at either side. The two lower formations afford an excellent foundation for the arch skewbacks. Seats have been cut back into the solid rock for a distance of about 20 ft.; while this may seem overly conservative, the increased cost was a small item, in view of the fairly low cost of removing the rock at this point.

A view of the site before construction began is shown in Fig. 2. This view, which looks toward the steel arch span of the Oregon Trunk Ry. (*Engineering News*, Aug. 11, 1910 and March 20, 1913), illustrates the character of the rock formation.

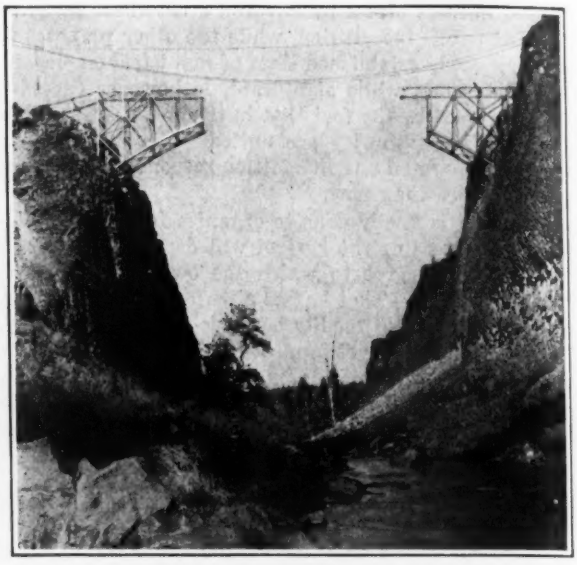


FIG. 1—CROOKED RIVER HIGHWAY ARCH UNDER CONSTRUCTION

View taken March 28, 1926. The arch has a span of 330 ft. 8 in. between the basaltic canyon walls. The absence of derricks from the bridge deck is due to the use of a "high line" cableway for placing the steel members.

Design of Structure—The arch supports an 8-in. concrete roadway slab 24 ft. wide between wheel guards.

FIG. 2—ROCK FORMATION NEAR SITE OF HIGHWAY ARCH—VIEW TOWARD OREGON TRUNK RY. BRIDGE

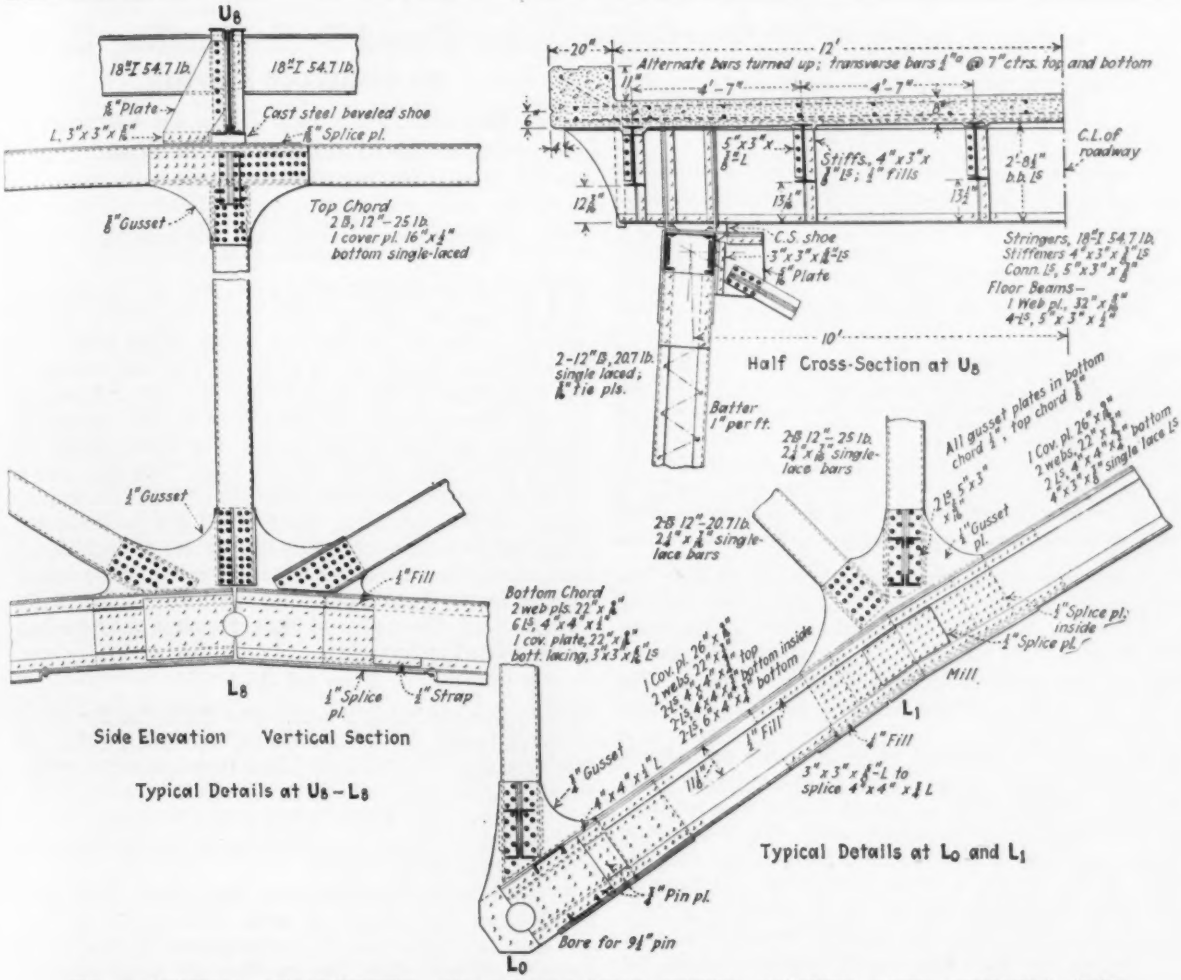


FIG. 3—GENERAL ARRANGEMENT AND DETAILS NEAR HINGES, CROOKED RIVER HIGHWAY ARCH

It was designed for a 21,000-lb. concentration in each traffic lane, followed and preceded by a load of 450 lb. per lin.ft. (Class A loading of the standard recently adopted by the American Association of State Highway Officials). The static live-loads were increased by an impact coefficient of

$$I = \left(\frac{36}{W+18}\right)\left(\frac{L+250}{10L+500}\right),$$

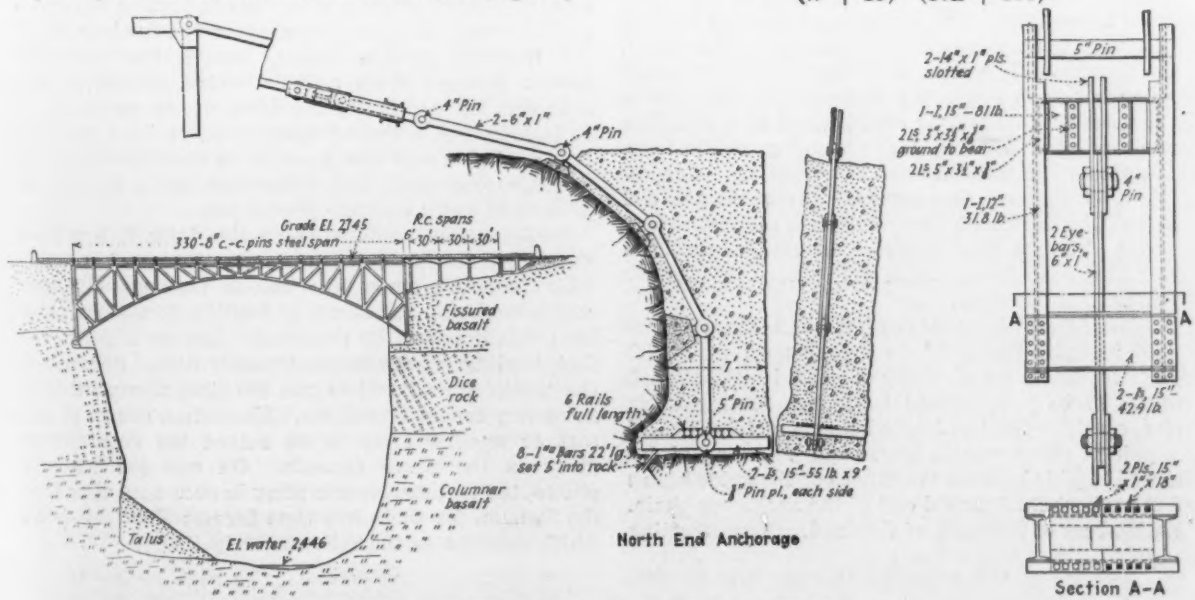


FIG. 4—NORTH ANCHORAGE FOR ERECTION

where W is width of roadway and L is loaded length of span for maximum stresses. The unit stresses used differed slightly from those used for other bridge construction throughout the state, the principal special figures being given in the accompanying table.

UNIT STRESSES USED IN COMPUTING SPECIFICATIONS FOR CROOKED RIVER BRIDGE

	Working stress, Lb. per sq.in.
Floor-slab concrete (compression)	750
Structural steel	15,000
Cast steel	15,000
Axial compression on gross section of structural steel.... (12,500 max.)	12,000 — 50 l/r
Bending on pins	22,000
Shear on rivets and turned bolts in floor connections, shop and field	7,000
Shear on other shop rivets and on pins	10,000
Shear on other turned bolts and field rivets	8,000
Shear on girder webs, net section	10,000
Gross section	8,000
Shear on cast steel	8,000
Bearing on rivets and turned bolts in floor connections, shop and field	14,000
Bearing on other shop rivets and pins	20,000
Bearing on other turned bolts and field rivets	16,000

The concrete stress, which is rather higher than has been used in this state for other floor slabs, was adopted to reduce the dead-load on the structure. The other unit stresses were assumed at a conservative figure owing to the general inaccessibility of some of the details for periodic inspection, and to the desire for maximum rigidity.

Hinge pins are provided at both crown and skew-backs, the structure being designed to act under dead load as a three-hinged arch and under live load as an arch with skew-back hinges only. To accomplish this, the two center sections of the top chord will be floated on the center vertical with blank end connections, until practically the entire dead-load is placed, at which time the holes for the joint connections will be drilled in the field and the structure fixed in its deflected position. For the small increment of additional dead-load and for the entire live-load the structure will act as a two-hinged arch, with the advantage of increased rigidity and a slightly better stress distribution throughout.

Curved gusset details have been employed for architectural appearance. The approach spans were planned with a view to a future park development at this point.

Construction—The steel is being erected by cantilevering out from temporary anchorages. For placing the members a cableway is used instead of a traveling derrick or other hoisting device running on the floor. This reduces the erection stresses materially. In view of the fact that erection stresses govern at the end panels of the top chord, there results a distinct saving in metal. The roadway stringers are omitted until the center hinge is placed, which will operate to further cut down these stresses.

During the cantilever stage of erection, the structure is tied back by means of an eyebar anchorage with adjustment by means of a pair of geared jacks at each corner. These jacks spread between a fixed reaction girder, consisting of two heavy I-beams rigidly detailed to a pair of side or guide beams and a floating girder designed to slide between the flanges of the guide beams and to support the forward end of the anchorage chain.

Kuckenberg & Wittman, of Portland, are constructing the bridge, under contract awarded to them last July.

The erection is being handled for the general contractor by the firm of Booth and Pomeroy of Portland.

What Should Be the Hauling Cost on Concrete Paving

Formulas and Tables Laid Down for Computing the Chief Cost Variable in Road Paving with Concrete

By J. L. Harrison
Highway Engineer, Bureau of Public Roads, Washington, D. C.

HAULING materials to the mixer is the one element in concrete paving work which may vary widely in cost from job to job. It varies, first, because it requires more work and so costs more to haul materials five miles than it costs to haul them one mile and, second, because on some jobs the haul distance can, by proper planning, be kept within rather low limits while on others it is unavoidably long. Long haul also has a tendency to affect cost adversely through the inadequate supply of transportation units which are so commonly employed on such work. But the matter of importance here is not what the effect of inadequate hauling equipment is on production costs but what the hauling itself should cost. To arrive at this, recourse may be had to the following formula:

$$T = 8d + 4$$

This is for one-batch trucks. For formulas for other styles of trucks, see *Public Roads*, December, 1925. In this formula, T is the round trip time—material yards to mixer and return—in minutes, and d is the distance from the material yards to the mixer in miles. From the formula, the accompanying table (except the last column) is easily developed.

In the table the column giving truck days is obtained by dividing the number of trips that should be had per day (average over the mile rather than for the distance shown) into the number of 5-bag batches required for a mile of standard 18-ft. Maricopa section pavement (here used as 2,350 batches). The column can be readily recast to show the time required to haul the material required for any other style of section. This column is the important one for it shows the amount of work actually to be done in hauling the materials for each mile of pavement as the distance from the material yard increases, though the following column perhaps gives a little better picture of the ordinary job as, in it, the time of an extra truck is included—this having been found to be a practice it is advisable to follow in order to avoid the effect of the numerous small time losses that are a feature of practically every concrete paving job.

Inefficiencies—In drawing up this table it has been assumed that the trucks are correctly operated. The table therefore shows the results that a contractor ought to obtain. In short, if hauling is costing more than this it is costing too much. But, as a matter of fact, hauling is not always efficiently done. Sometimes the trucks are allowed to run too slow, though this is not a very common condition. More often delays of one sort or another creep in to extend the constant as given in the above formula. On one job recently visited, the trucks were operating in such a manner that the formula for their trip time became $T = 8d + 10$ which resulted in the following trip times:

1 mile	18 minutes	Trips per day 33
2 miles	26 minutes	Trips per day 23
3 miles	34 minutes	Trips per day 17

The effect of this on the day's output will be seen by making a comparison of the trips per day made on this job with what should have been obtained as shown in column 2 of the general table.

The constant in this formula is the time required for such operations as loading the trucks, driving through the material yard, turning the truck and backing it to the mixer and waiting at the mixer. Of course, these operations must be repeated with every load taken out. Moreover they are of such a nature that the length of the haul does not affect them. In fact, the length of haul only affects the driving time which, in the formula for single-batch trucks, is covered by the $8d$. As the constant is affected by any low efficiency in loading, in turning, or by delays at the mixer, as well as by recurring stops of any variety, all of these should be checked at once if the trip time does not agree with that shown by the formula given above.

TABLE FOR COMPUTING HAULING COSTS USING SINGLE-BATCH TRUCKS

Haul Distance in Miles	Single-Batch Trucks — Minutes per Trip	Trips per 10-Hr. Day	Truck-Days**	*Truck Days Including Extra Trucks	Cost at $10 per Day	Cost by Hired Trucks at 30c. per Batch Mile
1	12	50	28	35	$ 350	$ 705
2	20	30	59	70	700	1,410
3	28	21	92	110	1,100	2,115
4	36	16	127	150	1,500	2,820
5	44	13	156	185	1,850	3,025
6	52	11	196	230	2,300	4,230
7	60	10	224	265	2,650	4,935
8	68	8	261	310	3,100	5,640
9	76	7	314	360	3,600	6,345
10	84	7	336	395	3,950	7,050

*Time of extra truck or trucks added to prevent unavoidable small delays.
**Truck days required to haul materials for 1st, 2nd, 3rd, etc., mile of paving.

With high-speed trucks the same general conditions prevail, but as the road conditions often are very bad, preventing any really high speed in operation, trucks of this sort may at times legitimately fail to maintain their standard trip time. This may also affect the trip time of other styles of trucks but is not as likely to do so. When such conditions obtain it behooves the contractor to give more attention to maintaining the roads over which his trucks must haul.

If the cost of operation is excessive it is almost always because the trucks are not making the proper number of trips per day. The most likely exception to this is where reckless driving is destroying the trucks but this is so apparent and so easily stopped that it hardly needs mention. The proper cost of hauling is, of course, the number of days' work that there are to do multiplied by the cost per day of owning and operating single-batch trucks. In the above table a cost of $10 per day has been used. The last column of the table results, this column showing the cost of hauling in each mile. Thus hauling between mile post 1 and mile post 2 (the second mile) should cost about $700 while hauling from the material yard to between mile post 9 and mile post 10 should cost about $3,600. In the nature of the case these figures are approximate, first, because they are based on a higher degree of perfection in truck operation than is commonly found in practice, and second, because the operating cost varies according to the cost of drivers, of gas, of tires, etc. The figure used, $10 a day, is rather a top figure, but any contractor who desires to make use of the figures given in this table can readily substitute his own figure on operating cost, if the basis here used is too high, and with this recalculate the last column.

Of course, if the trucks are not making the proper number of trips a day, the cost as given for any mile will be exceeded. Improper servicing of the truck—that is, long loading delays, poor plant arrangement, lax driving, etc.—have been noted as adversely affecting the trip time, thereby increasing cost. Another important matter is lax job administration. Many jobs, though supposed to work 10 hours a day, actually work only 7 or 8. One job that was visited last summer worked only 150 hours during July, 142 hours of good working time having been lost through lax administration of the work. This job was supposed to work 11 hours—the balance of the time having been reasonably lost on account of rain. Under conditions of this kind, truck cost mounts rapidly. Cases as bad as the one just mentioned are not perhaps very common but a good many figures have been collected which tend to show that the average time lost per day exceeds 2 hours. Where a job is so managed that only 7 or 8 hours' work are done, production is correspondingly reduced and the cost of hauling is increased. Taking at random the fifth mile as shown in the table, instead of an average of 14½ trips per day—$(16 + 13)/2$—per truck employed on this work, an average of only about 10 trips per day would be had if only 7 hours' work is done and about 11½ trips per day if 8 hours' work is done. The cost of hauling would, by this practice, be increased from about $1,850 for this mile to about $2,650 for the 7 hours' work per day and $2,300 for the 8 hours' work. The assumption here is that a full day is paid for though but 7 or 8 hours' work is done. Commonly this is the case as the delays which in their total amount to 2 or 3 hours a day accumulate a few minutes here and a few there, as when the job starts a little late, the mixer stops a few minutes because of a minor adjustment, a pipe line bursts, work is stopped a little early at night, etc., but even if wages are paid according to the time worked the adverse effect of the short day is not wholly eliminated.

Job Conditions and Owning and Renting Trucks—The manner in which the cost of operating privately owned trucks approaches the cost of renting trucks as the hours of operation per day are reduced, shows both why rental prices are so high and why it is so often stated that renting trucks is cheaper than owning them. There really are a good many jobs that do not average 7 hours' work per good working day and quite a few that get nearer 6. Poor management is the cause, but high cost is the result. Indeed the high cost of renting trucks is directly traceable to job conditions that reduce the number of hours worked per day to a low average.

Finally, though it may seem strange that this should be the case, the use of too many trucks is a common cause of high operating cost. A proper cost can be secured only by sending onto the job each morning the right number of trucks. The contractor who has just the right number of trucks for a 3-mile haul rents no additional trucks when the haul is 5 miles, and so increases production cost by reducing the production of the mixer, but when the haul is only a mile and a half he still sends out all the trucks with the result that time lost at the mixer sharply reduces the number of loads that are handled per truck. The writer has seen production cut in this way to as low as 60 per cent of capacity. Reductions of output to as low as 70 per cent or 80 per cent of capacity are common. Actual inefficiency in the operation of the truck train, as discussed above, may also produce the same result.

But where the output per hour is cut either by poor management in the operation of the trucks or by the use of too many trucks, the daily cost of operation is reduced very little, if at all, with the result that operating cost, in practice, increases about as fast as efficiency in operation falls off. Of course, where the output is reduced in these ways, and the number of hours' work is reduced at the same time, the result may be very bad indeed. Thus operation for only 6 hours a day at 80 per cent of proper delivery reduces the output of the trucks to 48 per cent of their real daily capacity. A 7-hour day at 70 per cent of proper delivery reduces output to 49 per cent of the full 10-hour delivery capacity.

The cost of hauling probably is not increased quite as much as production is decreased by the combined effect of low efficiency and short hours, but the style of operation often is such that the difference is not great, so where management is lax the hauling cost may, and indeed often does, amount to a great deal more than the figures given in the table with this article, which are of course for first-class operation. If, however, hauling is costing more than the figures given in this table, it is likely that the cause is to be found in one of the reasons given above and that once located it can readily be corrected. The cost of concrete roads should be reduced, but if it is to be reduced to what it ought to be and at the same time a profit is to be made by the contractor, the cost of hauling must be very carefully watched.

Replace Cast-Iron Turbine Runners Quickly After Failure

Two Wheels in Copco No. 2 Plant Fail in Service Due Apparently to Subsurface Cracks in Runner Castings

THE cast-iron runners of the two identical 20,000-hp. vertical reaction turbines of the Copco No. 2 plant of the California Oregon Power Co. on the Klamath River in northern California failed in service Nov. 7, 1925, and Jan. 17, 1926, respectively, but quick work on the part of the manufacturer in casting and shipping new runners permitted replacement inside of 60 days from the time of the first shutdown. Unexplained cracks in the castings were apparently the cause of the failure.

Copco No. 2 plant is on the Klamath River, about one mile below the older Copco No. 1 plant. The No. 2 plant contains two 20,000-hp. vertical reaction turbines equipped with cast-iron runners, operating under an effective head of 140 ft. (157 ft. static). The normal speed of the wheels at full gate is 171.5 r.p.m., the specific speed, 51. The first runner castings weighed approximately 15,000 lb. apiece and had an outside hub diameter of 8 ft.

The plant was put in operation July 15, 1925. On Nov. 7, 1925, after a 2,000 hr. period of operation, the operator of the plant noticed a curious rumble or subdued crash in the turbine pit of unit No. 1. The sound lasted only a few seconds and the speed of the unit was not affected, because the generator remained paralleled with the power line. It continued to operate as before, except the generator dropped its load and the operator reported that he could not pick it up again. The unit was then shut down and an examination of the exterior only did not discover any abnormal conditions. The unit was then started again and brought to speed although it was noticed that a considerable gate opening was required. When it was attempted to put the field on the generator the turbine was unable to hold the speed. This prompted a complete shutdown of the unit and an examination of the interior of the casing and of the runner. It was found that all the runner vanes were gone, having been broken off and carried down the draft tube, leaving only short stubs on the hubs to which the upper ends of the vanes had been attached and on the ring that encircled the lower end. When the vanes were carried away, the ring, being then free from all connection with the shaft, dropped down a few inches and rested on the draft-tube liner. The wheel was revolving under the pressure on the short stub ends left on the hub.

Inspection of the main stubs on the hub and ring showed that some pitting had occurred on the trailing sides of all the vanes near the bottom and on the shroud ring adjoining where the water had gone away from the vanes and it was decided to inspect the runner of No. 2 to see if similar conditions existed. On inspection of unit No. 2 it was found pitted in a similar manner but not to the extent of the pitting shown in No. 1, though No. 1 had been in service some 300 hr. longer than No. 2, which might have accounted for the difference in degree. Further examination of No. 2 runner, however, showed that seven adjoining vanes out of the total of 19 had cracks, apparently shrinkage cracks, at their tops near the hub from which they were supported. These cracks extended entirely through the middle and ranged up to 17 in. in length, thus leaving only 4 or 5 in. of metal on the outer or inlet edge holding the vane in place. With this in evidence, further examination of the stubs on unit No. 1 was made resulting in the belief that these cracks and not the pitting were the factors that caused the collapse of unit No. 1.

The condition in unit No. 2, however, was so precarious that the manufacturer decided to cast a new runner for No. 2 at the same time as for No. 1. The original No. 2 was continued in service until Jan. 17, when, after a total of approximately 3,000 hr. of operation, two of the cracked vanes broke away, and that wheel, too, was shut down, to be replaced immediately by the new wheel on which work was already progressing.

Work on new runners was rushed by the manufacturer and by special arrangement with the railroad companies and with a tracer following each car to destination and an erecting engineer to superintend the replacement work on the ground, unit No. 1 was put in service Jan. 8, six days after arrival of the runner at the plant. Unit No. 2 was out of commission Jan. 17, the new runner was on the ground on the next day, and the unit carried commercial load again on Jan. 23. In view of the expediency of replacing the runners with the least possible delay the changes made were limited. The vanes were thickened up without causing serious reduction in output capacity and slight changes were made only by flattening the curvature. In all about 5,000 lb. of metal was added.

The new wheels have continued to operate satisfactorily.

Old Earth Dam on the Pequannock in Northern New Jersey

Stone Batter Wall Backed by Rock Fill and Earth Embankment—Cross-Section Follows Present Practice Closely

By J. Albert Holmes
Hydraulic Engineer, Division of Water, Newark, N. J.

OLD DAMS of earth and stone frequently mark the locations of early forges and furnaces for iron making in northern New Jersey. Five of these dams were located within a distance of two miles on the headwaters of the Pequannock River. At one of them pocket cutlery was made up to as late as 1905. At another the forging of anchors ceased in 1879. A third, known as the Warner dam, has not been in use for more than sixty years. Slag dumps indicate that iron was manufactured here also.

The writer can relate little of the history of the dam, except that it was not in use in 1865 according to a resident of the district; that the railroad just north was built in 1870-71 and the highway was relocated and an underpass constructed in 1905. The relocated highway cut through the east end of the dam and disclosed the nature of the earth fill. A widening of the cut in 1925 gave still better information.

FIG. 3—FRONT OF PORTION OF OLD BATTER WALL
View taken from camera location *B*

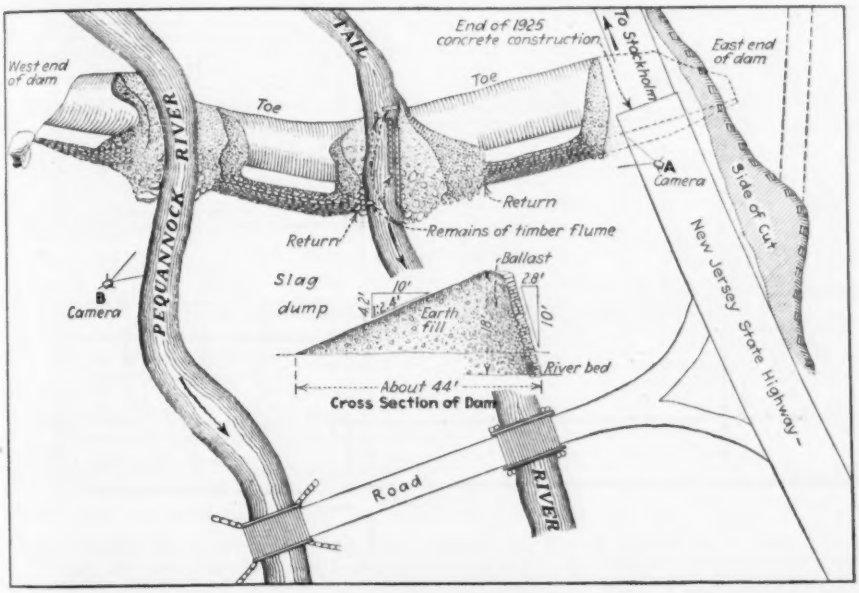


FIG. 1—PLAN AND CROSS-SECTION OF OLD WARNER DAM IN NEW JERSEY

FIG. 2—CUT THROUGH DAM SHOWING WALL AND FILL
This view is from camera location *A* on Fig. 1 and shows cut made in 1925 for new concrete highway.

The dam is in a glaciated region and glacial drift was used in its construction without selection or removal of small boulders and stones. Nor is there evidence of placing in layers, though this must have occurred in a rough manner in order to support the heavily battered downstream wall during construction. The earth was probably moved onto the fill in ox carts and the stone for the wall dragged across the fill on stone-boats, all tending to compact it. The time element also entered into the problem to assist in the compacting. The construction force being small, the fill was not quickly made and also must have waited on the building up of the wall. At the other openings through the dam the ballast backing of the wall may be seen as well as the earth fill. In the middle section, Fig. 3, the wall is more heavily backed with ballast than in the end sections. The stones of the wall are rounded and rough split and irregular but were laid true to line and batter and have maintained both batter and line. A few stones have fallen from the top but the crests of the three sections are at the same elevation.

The dam was originally about 300 ft. long, it has a base width at present of about 44 ft. and a maximum height above the river bed of 18 ft. and a crest width of 6 to 7 ft. The upstream or earth face of the dam has a slope of 1 on 2.4 and the downstream wall a batter of 2.8 ft. per 10 ft. rise. The only evidences of an outlet structure are a few timbers in the middle gap that were probably a part of the flume foundation. At the edges of this gap are returns in the wall, laid up with the same batter as the face of the wall. The spillway may have been here also but it is more reasonable to suppose it was in the line of the main stream at the westerly gap—no trace of the spillway remains.

Pneumatic Filter-Alum Conveyor for Minneapolis Water Filters

Bulk Granulated Alum Moved from Freight Cars to Storage Bin and to Service Hoppers Above Dry-Feed Machines

By J. A. Jensen
Engineer, Water Department, Minneapolis, Minn.

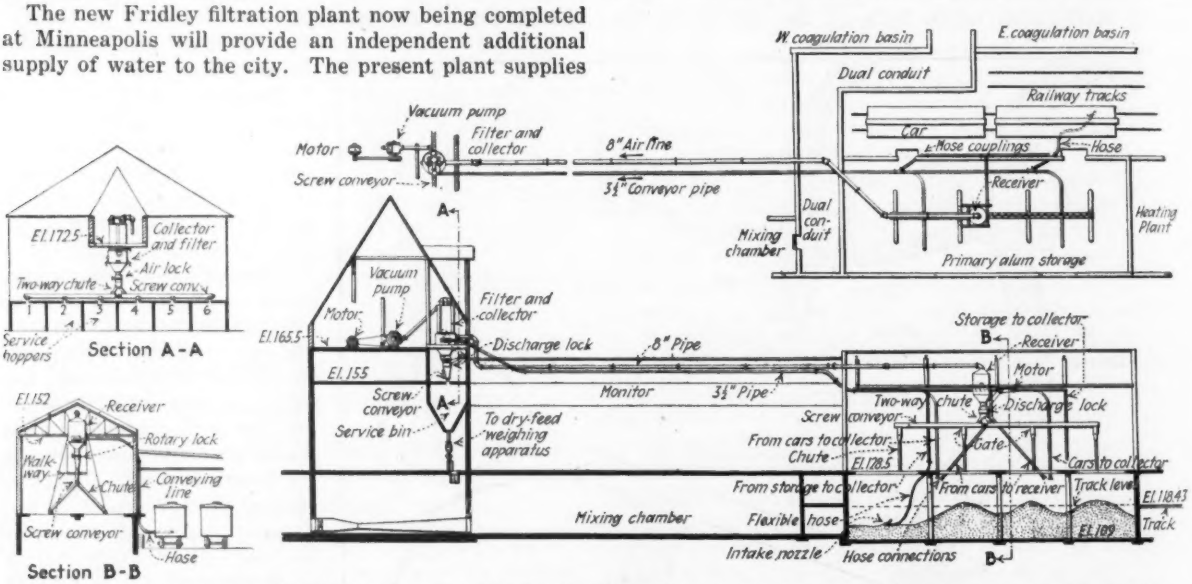
WHAT is probably the first pneumatic alum-conveying apparatus ever provided for a water filtration plant is being installed by the city of Minneapolis at its new or Fridley plant. The equipment unloads bulk granulated alum from freight cars through intake nozzles and hose and delivers it to service bins placed above dry-feed machines. This delivery may be either direct or after primary storage in a large bin —for which practically the same pneumatic pick-up and delivery system is used.

The new Fridley filtration plant now being completed at Minneapolis will provide an independent additional supply of water to the city. The present plant supplies water from the Mississippi River to the filters at Columbia Heights from which the delivery is by gravity to the distribution system. As this plant is rather remote from the southwestern part of the city, where the greatest growth is taking place, considerable difficulty has arisen in the matter of maintaining satisfactory pressures in the distant sections without resorting to local repumping during the summer months. During the season of 1925 the demands upon the Columbia Heights plant exceeded the nominal capacity of the filters, making necessary either an expansion of the existing plant or an independent supply. Anticipating this situation and a continued future development in the same general vicinity which is now suffering from low pressures, the Fridley plant was designed to meet these demands.

The new plant is located above the city and at the river. It will have an ultimate capacity of 160 m.g.d. The initial construction calls for a capacity of 40 m.g.d. Besides the filter plant proper the project includes a low- and high-service pumping station which will take the supply from the river for the filters and subsequently deliver the purified water to the more remote portion of the distribution system which the present gravity supply fails to serve satisfactorily under peak-load conditions. Thus the city will be supplied with water from two sources, one by gravity from the Columbia Heights reservoir, and the other from Fridley by direct pumping, the two supplies equalizing in the central and southern portions of the system in what might be termed a semi-gravity distribution.

In the design of the new plant considerable attention was given to the mechanical equipment. The apparatus for handling alum is of especial interest on account of the arrangement of the plant. The chemical house is located on the river side where the raw water enters the control chamber, while the trackage serving the plant could be obtained only from the opposite side. In the location of storage, this as well as the economical factor has to be considered. One of the lessons of the World War and transportation conditions following it was the necessity for ample alum storage. To provide this in elevated bins in the chemical house would require large hoppers and massive construction, while storage at track level and adjacent to it could be provided quite economically. In either case the alum would have to be rehandled and reconveyed to the dry-feed apparatus.

On account of the layout of plant referred to and for economy of side-track bins and conveying apparatus, it was decided to provide primary storage at track level and elevate the supply of alum to service hoppers as required for use. As the treatment is to be by the dry-feed method, the alum will be provided in the ground or granulated form. It will be shipped in bulk in paper-lined box cars, such as are used for grain in this region. On arrival the cars will be set inside the building under cover and alongside the primary alum storage bins. The bins are of reinforced concrete with cross-walks at the top level. They have a capacity of 1,600 tons of alum.



PLAN AND SECTION OF PNEUMATIC ALUM CONVEYOR FOR NEW WATER FILTRATION PLANT AT MINNEAPOLIS

Bulk granulated alum from freight cars is drawn through nozzles, hose and pipe to receiver from which it is either delivered right and left by screw conveyors into a large storage-bin or else is bypassed to and through a collector to service bins over dry-feed machines. If stored, the alum is subsequently picked up and conveyed by the same means. Motor-driven vacuum pump at extreme right supplies suction. Filter over collector removes dust from air carrying alum.

The service hoppers are located in the chemical house. The alum will be conveyed from primary storage to the service hoppers through a distance of 165 ft. and be raised 46 ft., exclusive of the additional travel through the conveying apparatus. The distance from cars to main storage is short and approximately at equal levels. The material, however, is raised through the receiving apparatus and deposited at four points of delivery in the bin.

The conveying equipment is of the high vacuum type. The apparatus consists of a steel receiver with discharge lock and a right-and-left screw conveyor located above the primary storage bin, and a second collector with air filters and discharge lock and a right-and-left screw conveyor located over the service hoppers in the chemical house. The vacuum pump and motor are located at the collector and air filter in this building. By this equipment it will be possible to unload granulated alum from the cars through intake nozzles and flexible hose lines and deposit it in primary storage, or divert it directly to the collector and air filter to be placed in the service hoppers. The material can also be taken in a similar manner from the main storage for supply to the service hoppers by a manipulation of the proper gates.

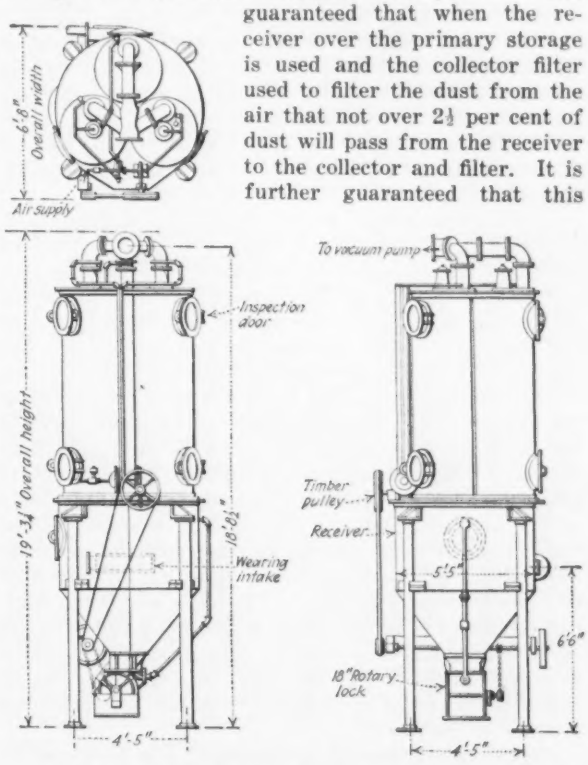
The pump produces a proper vacuum through the air line on all of the enclosed apparatus. The conveying line is opened in the car and vented in the material. The high velocity of the relief carries the alum away in suspension with the current produced. On entering the receiver the velocity of flow is reduced by the sudden increase of volume in the chamber and the alum is dropped to the bottom of the cyclone and ejected through the rotating lock. The collector operates in the same manner. The exhaust air is passed through the filters for the removal of the dust which it has carried over.

At the present or Columbia Heights plant five men, wearing masks, are required to remove alum from the freight cars. A part of this is crushed alum in bulk and part granulated alum in bags. By the vacuum system two men will manipulate the suction nozzles and other mechanism without inconvenience.

The equipment includes: (1) A high-vacuum rotary pump with water seal. (2) A cylindrical steel receiver, calked airtight, with rotary discharge lock and stabilizer; motor and countershaft with speed reduction for operating the right-and-left-hand screw conveyer for the distribution of the material in the primary storage bin. (3) A combined collector and air filter with rotary discharge lock, stabilized and operated by countershaft for speed reduction by motor which also controls timing mechanism for self cleaning filter units; also right-and-left-hand screw conveyor for placing material in any one of six service hoppers. (4) A 50-hp. motor for operating the vacuum pump; for operating the screw conveyors and other mechanism there are two 5-hp. motors. (5) One pipe line from primary storage and cars to collector, one line from cars to receiver and one from receiver to collector to pump for exhaust purposes. Flexible conveying hose with special intake nozzles, valves and fittings are provided for the desired control of the material.

The air filter consists of three pneumatic self-cleaning compartments erected upon the top of the cylinder of the collector. These are equipped with automatic timing mechanism for shaking the filter bags and removing the dust from the air used in conducting the material. The bags are flexible canvas tubes, 21 in number, in three sets of seven each. One set at a time is automatically cut out of service for shaking, leaving two sets in service during the interval. The cleaning continues in rotation during operation. The total filter area is 315 sq.ft.

The pump will produce a vacuum of 12 in. more or less as required to meet the conditions. The equipment is guaranteed to move granulated alum from the cars to primary storage at the rate of 12 tons per hour, or from cars and primary storage to service hoppers at the rate of eight tons per hour including hook-ups. It is also guaranteed that when the receiver over the primary storage is used and the collector filter used to filter the dust from the air that not over 2½ per cent of dust will pass from the receiver to the collector and filter. It is further guaranteed that this dust will be retained on the special filter fabric so that there will be no visible dust loss at any point, and that there will be, under no conditions, a loss to exceed 0.1 per cent.



AIR FILTER FOR PNEUMATIC ALUM CONVEYOR

The primary storage bin has a capacity of 1,600 tons of alum, which at present is a six months' supply at maximum rates of application. When the plant reaches its ultimate capacity the supply will meet maximum conditions for a period of 45 days. The service hoppers are six in number, each having a capacity of 30 tons of alum. They will each require refilling every two to four days under varying alum titrating rates.

The vacuum system of conveying granulated alum has one disadvantage where volumetric dry-feed machines are used. When a quantity of alum is being conveyed, the process causes a separation of a portion of the dust and fines, which at the air filters becomes separated from the rest of the bulk and is deposited in the service hoppers. On filling the hoppers for supply with the ordinary-sized material there will result a stratified layer of fines between layers of the ordinary material. When this alum is measured out the volumetric ma-

chine will encounter coarses and fines alternately which will interfere with the accuracy of the weights delivered. This is due to the differences in weights of the same volumes of material of different fineness and their variable mixtures. The remedy for such conditions can be found by a change in the practice of application of dry granulated alum. The basic laboratory determination of alum rates is in term of grains per gallon and therefrom is determined the equivalent pounds per minute or hour for any given flow of the water supply through the plant. From this known rate the practice has been to secure the application by causing a volumetric measurement of the alum instead of using weights. Due to this variation in the grading of the grains of alum in the mixture resulting from pneumatic conveying, a method of checking the rates of application by weighing is being worked out which will insure greater accuracy and consequently considerable economy in the use of alum. This method is not expensive in the installation required and is not affected by the sizing or graduation of the fineness of the material handled.

In the Fridley plant there will be four 40-m.g.d. mixing chambers. Ultimately there will be six dry-feed machines of the automatic weighing type, one machine for each of the six service hoppers. This arrangement will afford a stand-by capacity of two extra machines and hoppers for any emergency that may arise. The discharge from the dry-feed machines will be into an overflow mixing box. The alum will meet an ascending current of water and be carried over a small baffle to the discharge side. From this point the mixture will be delivered into the expanding section of the venturi meter just before the flow impinges on the first baffle in the mixing chamber. The mixing chamber baffles are graded in their spacing so that from the meter to the last bay of the chamber the agitation of the water will be decreased gradually, or in other words the alum will be admitted to the water at the most violent point of agitation and the mixture will gradually reach a quiescent state at the entrance into the coagulation basin, which is in accordance with the recommended practice of the day.

The pneumatic conveying equipment was furnished to the Fridley plant by the Dust Recovery & Conveying Co. of Cleveland. The Fridley filtration plant was designed by the engineering department of the Minneapolis water-works and the construction carried out under the same supervision. N. W. Elsberg is city engineer, J. A. Jensen, engineer, Water Department, and C. C. Wilbur, assistant engineer in charge of the construction.

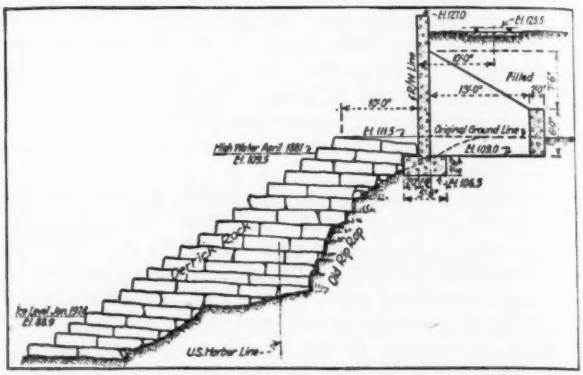
Drainage Costs Near Albuquerque

The cost of draining 3,470 acres of flat, alluvial flood-plain lands of the Pueblo Indians near Albuquerque, N. M., was $10.68 per acre. The details of costs per acre as given by H. F. Robinson, supervising engineer, U. S. Indian Irrigation Service, are as follows: Excavation with dragline, $3.85; depreciation of dragline, $1.08; superintendence of dragline work, $0.33; rock excavation, $1.40; superintendence of rock work, $0.12; structures, $3.25; superintendence structures, $0.30; engineering, $0.35. The work was completed last year and much of the land has already been flooded to leech out the alkali and subsequently be put under cultivation.

Cellular Retaining Wall for Railway Fill Along River Bank

JUST south of the new St. Paul Union Depot, the approach tracks run along the bank of the Mississippi River, at the top of a sloping bank, where original ground level is about 20 ft. above water level and track grade is 16 ft. higher. To hold the fill along this stretch of track, a retaining wall of cellular type is used, as illustrated in the sketch herewith.

The cellular type of retaining wall was chosen here because it introduces the least toe pressure on the footings of all types of retaining walls, according to G. H. Wilsey, chief engineer of the St. Paul Union Depot, who describes the work of the January issue of the Bulletin of the Minnesota Federation of Architectural and Engineering Societies. The wall



CELLULAR RETAINING WALL AND RIPRAP REVETMENT ALONG MISSISSIPPI RIVER, ST. PAUL UNION DEPOT

One block of the wall is of the section shown and stands at the top of riprapped slopes. Design of wall was varied in other blocks.

footings rest on the soil direct, without piles. The wall was built in 30-ft. sections, with two backstays in each section. Its height ranges from 16 to 27 ft. above ground.

The section shown, with derrick stone revetment of the river bank, extends one block from Minnesota St. north to Robert St. The footing of the wall here is about 5 ft. below original ground level, and the riprap was carried up to the latter elevation. In the next block north, from Robert to Jackson Sts., this riprap is not used, but a toe wall was built along the harbor line, from El. 87 to El. 108, over a line of sheetpiling 18 in. back of the face of the wall. The back of the wall is irregular, being carried to contact with an old dry-stone wall whose ability to hold the bank was in doubt. Near Jackson St., where the tracks swing away from the river, the toe wall was omitted and the cellular retaining wall construction was carried down to El. 97.5.

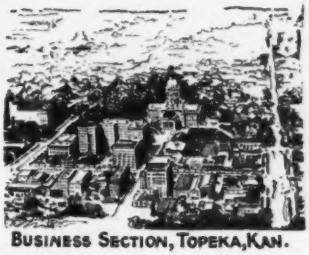
Elsewhere in the Union Depot work, retaining walls of gravity type were used. These are 18 in. wide at the top, and have vertical face and a batter of 1 in 3 on the back; footings are 5½ ft. thick, with base 6 ft. below the surface. Except at a few special points, no piles were used in founding these walls. They were concreted in alternate 30-ft. sections, and although there has been a certain amount of subsidence at a few points, no cracks have developed from either settlement or temperature effects.

Engineering in the Small City

A series of notes from the field on the Problems and Practices of the Municipal Engineer in the Cities Below 100,000

The Editor Visits the City Engineer

Snapshots of Our Representative Small Cities



BUSINESS SECTION, TOPEKA, KAN.

Topeka, Kansas

STATE CAPITAL OF KANSAS. Situated on the Kansas River in Shawnee County, 67 miles west of Kansas City. Served by the main lines of the Chicago, Rock Island and Pacific, the Union Pacific, and the Atchison, Topeka, and Santa Fé railroads and a branch line of the Missouri Pacific R.R. The general offices of the Santa Fé railroad, employing 7,000 persons, are located here. Bus lines radiate in all directions over concrete and gravel roads into a rich farming and dairying community. Topeka is largely a residential city; Washburn and Bethany denominational schools are located here. Industrially Topeka has large railway repair shops employing 4,000 men, a large publishing company, meat packing plant, a poultry and egg packing plant, a flour mill, an airplane factory and a large creamery. Settled in 1854, incorporated 1861. Pop. 67,300.

FORTUNATELY, Topeka, the capital city of Kansas, can be described as flat. For what "foreigner" would think otherwise? It is not as flat as some, nor as rolling as many other Kansas cities but the maximum grade on any street is 2 per cent. Incidentally, these streets are all very wide and lined with many trees, thickly foliaged in season.

Topeka was the second city founded in Kansas after the state was thrown open to white settlers who in this case were members of the New England Emigrant Aid Society. An extract from a Kansas history says: "A meeting was held in the forenoon of Dec. 4, 1854, and the nine men—strangers a few days before—then and there staked out the town. Articles of agreement were drawn up by which the town site was divided into 100 shares, each member to receive one share, the remainder to be reserved for future settlers. The proposed limits of the city were 2 miles east and west along the Kansas River and 1½ miles north and south upon the prairie. It was surveyed into lots 75x150 ft., the Levee to be 130 ft. wide and four of the principal avenues each way crossing transversely the same width; the remainder of the streets to be 80 to 100 ft. wide." According to a report on Jan. 13, 1855, in the *Herald of Freedom*, the first newspaper in Kansas, "the name is said to be the original Indian one for the Kansas River."

Engineering in Topeka is taken to mean the preparation of plans and specifications for and erection supervision over new work only, these being the major functions of the city engineer.

All maintenance work is done by men without technical training. The superintendent of streets, however, has held this position for twenty-five years and his work in cleaning and repairing the streets is carried out very efficiently. In fact, there arises in connection with the latter one of the important phases of the local engineering situation—the laying of approximately 35 miles of asphaltic concrete in old brick pavements.

The famous patent litigation suits over asphaltic mixtures arose in connection with their use in Topeka and the resulting publicity has made "Topeka-mix" a byword in engineering circles. The original Topeka mix modified to a certain extent is the wearing surface still applied to many of Topeka's pavements.

Administration—Topeka has had a city engineer since 1885. W. E. Baldry, an associate member of the Am. Soc. C. E., has been city engineer since 1917. He holds the record for continuous service in the position. His is an appointive position under the board of city commissioners. Topeka has had the commission form of government since 1915.

The commission consists of five members whose titles and duties are as follows: mayor, supervision over police and fire departments; commissioner of water and light, supervision over water-works and the city-owned and operated street lighting plant; commissioner of parks and public property, repair and maintenance of public buildings (except schools); the commissioner of finance; and the commissioner of streets. The city engineer is directly responsible to the commissioner of streets and occupies a parallel position to that of superintendent of streets although having some advisory powers over the latter office.

Even though the city engineer has no maintenance duties, the amount of work he has to do is very large. The Kansas law requires the city engineer to make an estimate on all public improvements wherein a bond issue is involved. The city engineer therefore plans all new work of any considerable magnitude without regard to the department or commissioner it falls under. Another state law that provides the city engineer with much design work requires a maximum tax levy of 1 mill per year for bridges in cities of over 40,000 population. As a result Mr. Baldry has designed and supervised the construction of reinforced-concrete bridges to such an extent that few steel spans remain in the city.

The organization of the city engineer's office consists of the following men in addition to the city engineer: an assistant city engineer, responsible for planning field work, a second assistant city engineer in charge of field parties, an excavation inspector, also answering to the superintendent of streets, responsible for repair of all street openings; three draftsmen; office clerks and stenographers and a superintendent of new construction. Under the latter is operated a system of inspectors during the construction season. Ten inspectors were used in 1925, a resident inspector on each job and a traveling inspector who visited every job every day. These men are generally recruited from older men, 50 to 60 years of age, who usually want to work only part of the year anyway and are willing to be paid by the day. Instruction classes are conducted for them each year by the city engineer.

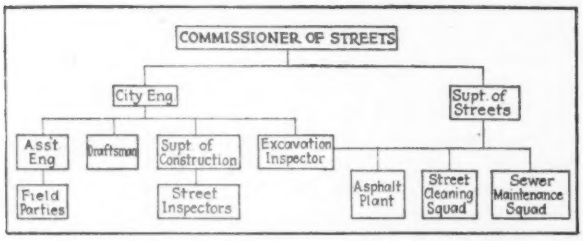
That the city is in good condition from an engineering viewpoint is attested by the fact that $53,000 of the 1925 budget was not needed and was re-apportioned in 1926 on the basis of the original budget.

No force account work is done, a state statute requiring that all work exceeding $2,000 be contracted.

Paving—Three types of pavement are used in Topeka, asphaltic concrete, using a modified Topeka mix, concrete and brick. Out of a total of 152 miles of streets 87 miles are paved with brick, 1½ miles with concrete and 33½ miles with asphalt, making a total of 122 miles. Thus, slightly over 80 per cent of the city's streets are paved. There are also 13 miles of alley and 250 miles of sidewalks paved mostly with brick. All of this paving is laid under the direction of the city engineer.

New paving work is paid for by a benefit district consisting of an area one-half block on either side of the street. If the district is not divided into blocks the district shall extend not to exceed 300 ft. on either side. This method of payment applies only to the street between intersections, the cost of paving the latter being always borne by the city at large.

A concrete base with a minimum thickness of 7 in. is used under all new streets regardless of the wearing surface. This base is of a 1:3:6 mix using 25 per cent natural cement and 75 per cent portland cement. The city engineer's reasons for specifying the use of part natural cement are interesting. All contracts for Topeka's streets must be mixed at a central plant of the contractor. The haul is sometimes over two miles. When using a pure portland cement concrete, much of the water would rise to the top of the load on the long



CITY ENGINEERING ADMINISTRATION PLAN, TOPEKA, KANSAS

hauls. As a result the concrete mass would not slide out of the truck, a pick often being necessary to loosen the load. By using one-fourth natural cement, the water is retained in the concrete making a plastic mass even after a considerable haul. Using 25 per cent natural cement also permits a 7-in. concrete base at the cost of a 6-in. layer made entirely from portland cement. Tests show that the resulting concrete is not affected in strength by the use of the natural product. This sort of concrete has been laid for the past two years and according to the city engineer is characterized by a sort of elasticity resulting in fewer cracks than formerly.

Street Maintenance—The superintendent of streets, as before noted, is practically a parallel officer to the city engineer. He has charge of the city's asphalt plant, the white winged squad for street cleaning and sewer maintenance.

The city levies an annual budget, $110,000 in 1925, the expenditure of which is under the commissioner of streets. This is spent mostly on maintenance as practically all new work is financed by bond issues.

Up-to-date mechanical equipment is used by the city such as mechanical sweepers and power flushers. The outlying districts are cleaned twice a month by a gang of workmen while the white winged squad daily

Engineering Work

patrols the downtown section. A general clean-up of the city is undertaken in April of each year or as soon as the frost is gone. The city at this time removes anything that the resident wishes to put out in his alley. This is paid for out of the budget. Snow removal is an inconsequential item.

Black Stripping on Brick Pavements—Topeka is completely converted to a program of brick pavement reclaiming by means of a 16-ft. asphaltic strip down the center or, on streets having car tracks, a strip on either side. The wonderful part of the program that appeals to the resident is that no special funds are necessary for this work. Approximately 50 per cent of Topeka's brick paving has been reclaimed by means of budget funds in the past nine or ten years. This is made possible by never extending the strip to the gutter which would then constitute new work and require special assessments. As it is, general taxation pays for this work which results in practically new construction.

Topeka at one time owned its own brick plant and to make the industry pay many miles of brick streets were laid. This was before any rattler tests had been devised and much of the brick is soft. Furthermore a two-course pavement (bottom course flat, top on edge) was laid on a sand base with a sand filler. Heavy traffic has caused serious wear on these streets and in addition buckled them in a longitudinal direction and corrugated them slightly in a transverse direction. The application of the strip coat spreads the load over a greater area and eliminates the wavy roughness of the pavement.

The program is to cover any brick pavement in the city at the request of a petition signed by 51 per cent of the abutting-property owners. In 1925 applications for 101 blocks were received and all laid. There are applications for 125 blocks of stripping on hand at the present time for 1926.

In applying the strip coat, the pavement is first flushed and broomed. In case it is greasy, naptha is used. The asphalt is hauled from the small city-owned plant capable of turning out about 1,000 cu.yd. per day. About $25,000 of the budget was devoted to this plant during 1925. The mix is a modified Topeka using 10 per cent asphalt, reducing the amount of chat from 25 per cent to 17 per cent and increasing the limestone dust and fine sand proportionately. This results in a denser mixture. The sand used is Kansas river quicksand obtained locally while the chats come from Joplin, Mo., being waste from the zinc mines. A very favorable material cost is therefore possible.

The thickness of the coat varies with the importance of the street ranging from 1 in. to 2½ in. The edges of the strip are usually carried out to a feather edge and it is along this that most maintenance is necessary. These edges have to be replaced at about two-year intervals. A method is being used now of blocking up the edges at about a 45-deg. angle between intersections. This is done by depositing the asphaltic concrete and tamping with a hot tool.

This stripping work was started in 1917. The methods, or mix, have not been changed. No repair work has been necessary except on the feather edges. The

Of the Small City

editor saw some of this asphaltic concrete put down on a full width street in Topeka in 1917. This street today is in excellent shape and according to the city engineer no repair work has been done upon it.

It is difficult to estimate a yardage cost for the work as the materials are brought into the asphalt plant during the winter when the men would otherwise be idle. Several other cost-saving schemes are in use. As near as can be estimated the cost is about 60c. per square yard average. Two-inch strip work would have to be let through contractors at $1.00 a square yard.

All cuts in the city's paving are made under the supervision of the excavation inspector working out of the city engineer's office but also under the supervision of the superintendent of streets. Only persons holding a public excavator's bond can open a hole in the streets. This is a $2,000 bond accompanied by a $25 cash deposit, the latter to be forfeited in case the city must do the repair work. The torn up pavement is restored at the excavator's expense under the supervision of the excavation inspector. Revenue from patching, the asphalt being purchased from the city, reached a total of $9,000 in 1925.

Sewers—Sewer design is comparatively easy as the land gradually slopes toward the Kansas River into which the sewage is discharged raw. Test borings are necessary on every project to determine whether rock is present or not, but as a general rule limestone lies about 15 ft. below the ground surface. Only in recent years have separate sewers been built. Plans are being prepared for four disposal plants using Imhoff tanks and trickling filters. It is interesting to note that bids are being received on a $120,000 contract for furnishing concrete sewer pipe to the city. This will mark the first concrete sewer installation in the history of the city. Again all design and construction of new work is under the city engineer while the repairs are made by the superintendent of streets. All sewage and water supply designs must be approved by the chief engineer of the Board of Health.

Water Supply—A new $1,500,000 mechanical filter plant was put in service in the spring of 1924. Prior to this water was taken from 250 sand points placed along the river. These finally became so clogged that a sufficient supply was not available. The new plant treats 5 m.g.d. of Kansas river water the year around. Steam turbines at the water plant provide current for plant operation and for city street lighting. The white way system in the business district is paid for on a front foot basis while the outlying lights are supported from general funds.

Zoning—Topeka has a very active zoning ordinance that restricts not only for occupational usage but also for height and area of openings between and behind the buildings.

Garbage—Garbage disposal is by hog feeding. The city has granted a franchise to a company to collect all garbage and pays a $2,500 a year bonus. Dead animals are disposed of through a rendering company. The city built a crematory for garbage disposal but it has never been used for this purpose. Egg shells, trash and feathers are now burnt here which provides a small revenue to the city.

British Columbia Legislature Authorizes City Planning

THE passage of a town planning act by the Legislature of British Columbia, on Dec. 18, 1925, leaves Quebec as the only Canadian Province without such an act, says the February *Journal* of the Town Planning Institute (Ottawa, Ont.), which prints the text of the act in full. The act is wholly permissive, but appears to give all municipal councils full power (1) to adopt a city or village plan—but chiefly for its own guidance in making public improvements—and (2) to adopt and enforce a zoning plan. Creation of a local planning commission is optional with each council, but these commissions would be advisory only, although, once created, their advice must be sought and considered in certain specified matters. Adoption of a plan does not bind a council to carry out improvements proposed in the plan, but departures from the plan must be referred to the commission "for its consideration and report."

Zoning powers granted by the act are broad. They require that councils, in framing regulations, must consider:

(a) The promotion of public health, safety, convenience, and welfare; (b) the prevention of the overcrowding of land and the preservation of the amenity of residential districts; (c) the securing of adequate provisions for light, air, and reasonable access; (d) the value of the land and the nature of its use and occupancy; (e) the character of each district, the character of the buildings already erected, and the peculiar suitability of the district for particular uses; (f) the conservation of property values and the direction of building development; (g) property shall not be deemed to be taken or injuriously affected by the passing of a zoning bylaw under the provisions of this section.

Boards of zoning appeal are made compulsory. They would consist of three persons, appointed one by the "council concerned," one by the lieutenant-governor of the province and the third by these two, the third to be chairman.

Where planning commissions are created they are to consist of 13 members in Vancouver, 12 in Victoria, 9 in other places having more than 5,000 population, and six elsewhere with a minority of ex-officio members in all but the smaller group of places, where this class would number half of the commission. The members would serve without pay. In all cases, the ex-officio members would include the mayor or (village) reeve, the chairman of the park board or committee, and the chairman of the board of school trustees, or, in case of a consolidated school district, a member of the board residing in the municipality, nominated by the school board. In Vancouver, the fourth and fifth ex-officio members would be the chairmen of the Vancouver and Districts Joint Sewerage and Drainage Board and the chairman of the Vancouver Harbor Commission.

Two or more planning commissions in contiguous municipalities may hold joint sessions to consider matters affecting all of them. Conclusions thus reached would not be binding upon any single commission, but must be reported to the corresponding council, with reasons for dissent, if there are such.

Low Death and High Accident Death Rate

The death rate of Richmond, Calif., is reported as only 4.63 in 1925 and 4.8 in 1924, according to the California *Weekly Bulletin* of Jan. 23. Of the 152 deaths due to all causes, 21 were due to accidents.

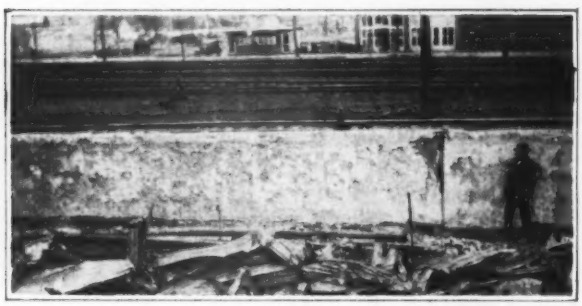
Repair Concrete Wall Damaged by Intense Fire

Strength Gone for Depth of 1 to 2 In.—Much Shattering at Joints—Repaired by Curtain Wall

By Alfred S. Fry
Morgan Engineering Co., Memphis, Tenn.

A SECTION of concrete levee wall was badly burned by intense heat in a conflagration which occurred at Newport, Ark., March 1, 1926. About 400 ft. of the wall was within 4 ft. of a large stave storage shed which burned with all its contents. Gale winds blew the flame horizontally directly against the wall until all of the shed and the staves were consumed.

The damaged wall, now six years old, is one portion of a reinforced-concrete levee which protects Newport from extreme floods in White River. It is of cantilever type, 8½ ft. high above the base, with the lower 3 ft. underground, and has a uniform thickness of 12 in.



BURNED FACE OF CONCRETE WALL, SPALLED AT THE EXPANSION JOINT
Corrugated metal was roof of stave shed.

It is reinforced vertically with ½-in. square twisted bars 5 in. c. to c., and in both faces with ½-in. temperature bars 12 in. c. to c. At the joints between sections 42 ft. apart, a ⅜x8-in. steel plate was embedded in the concrete to prevent floodwater coming through the joints. The sections were separated with an asphalt joint.

The stave shed was an open structure consisting simply of a corrugated-iron roof supported on wooden posts. Cypress staves were piled in this shed to a height of 12 to 14 ft. and a width of about 20 ft. The flames from this burning material were blown at the wall like a blowtorch by the wind, and caused unusual and quick expansion of the wall, the side next to the flames necessarily showing the greater expansion. The provision for expansion, although ample for ordinary temperature ranges, proved insufficient for the high temperature; at each joint a triangular-shaped block of concrete was cracked and shattered loose for about 3 or 4 ft. either side of the joint, down nearly to the ground surface. All of the asphalt joint material was burned out. The top 4 to 6 in. of the wall was generally cracked loose and where the flames were hottest flaked off. The part of the top cracked off is that above the vertical reinforcing and although reinforced longitudinally with temperature steel, nevertheless cracked on a horizontal plane below the top longitudinal bars. Lower down the vertical reinforcing, which was on the fire side, prevented cracking.

The face of the wall was seriously burned down to the ground surface. All of the strength was burned out of the concrete to a depth of from 1 to 2 in. so that the concrete popped off in some places and generally was sticking to the wall about as the same amount

LOOKING DOWN ON EXPANSION JOINT OF WALL
Fire side is below. Asphalt was burned out.

of sand would do with no cement mixed with it and was nearly as easily removed. The coarse aggregate, White River gravel, cracked and became friable under the heat, and halves of some pebbles were split loose while the other halves were held firmly by the good concrete underneath the burned surface. The burning discolored the concrete to a scorched brown. The sound concrete underneath still showed up a good gray color after the burned surface was removed. In the hottest sections, the expansion during the fire and contraction which followed later produced vertical cracks along the vertical steel which extended from the steel outward through the injured concrete.

Although the flames were entirely on the river side of the wall, the land side showed evidence of the fire. In some places, shallow patches of concrete from the size of a dollar up to the size of a hand popped off. Along part of the wall, a white efflorescence appeared generally along the horizontal lines, evidently being salts dissolved in moisture driven out by the heat.

On account of the possibility of a flood occurring during the time following the fire, the work of repairing the wall was begun within a few days. The outer surface of the wall was scraped down with ordinary mattocks which were found to be efficient tools for this work. Fortunately the concrete was not burned beyond the main vertical reinforcing and the bond on practically all of the bars was still in satisfactory condition. The

EFFLORESCENCE ON OPPOSITE SIDE FROM FIRE

loosened top was broken off with chisels and sledges for an average depth of about 6 in. A curtain wall 6 in. thick was then poured against the river side of the old wall monolithic with a new cap and a coping which projected down on the land side of the wall to form a hook tie over the injured part of the old wall. This new wall serves primarily as a protection wall and

is reinforced as such, since the reinforcing in the old wall is in satisfactory condition to carry the stresses to which the wall may be subjected.

At the joints, the old concrete was torn down to the ground surface for a distance of about 4 ft. each side of the joint and an entire new section of the wall was poured. The reinforcing bars in the old wall, extended down into the base of the wall and were left sticking up when the old wall was broken away. These bars were bent outward and the new wall was poured around them so that they form the main cantilever reinforcing in the new piece of wall the same as in the original construction.

Flood-Protection Plan Proposed for Paris District

Latest Project Would Divert Almost 1,000,000 Cu.M. per Hour from Marne at Neuilly to Seine at LaBriche

AMONG the most recent plans devised to forestall recurrences of dangerous floods in the Paris district is that which is described in a recent issue of *Le Genie Civil*. This plan, which comes after a rather disastrous winter, is described by E. Maynard, retired engineer, Ponts et Chaussées.

It is planned to intercept the waters of the Marne River at Neuilly, and by means of a regulating dam carry the flood waters first through a section of gravity canal, then raise them by electric centrifugal pumps to the top of a small divide, whence by pipe and open channel they will be diverted into the Seine at LaBriche.

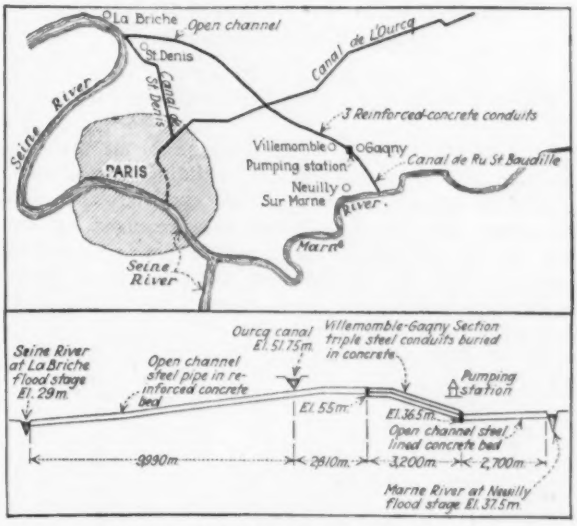
Referring to the figure herewith, this diversion channel will consist of three principal parts. The first section would utilize the streambed of an almost dry creek and be known as the Canal de Ru St. Baudille. The length would be in the neighborhood of 2,700 m. From the end of that open gravity canal water would be raised almost 20 m. through triple steel conduits bedded in concrete. The second section would be about 3,200 m. long. The last section would be a gravity channel of a length of over 12,500 m. extending from the end of the triple steel conduits to the Seine River. This last section would encounter the Ourcq Canal, which it is proposed would be underpassed by a siphon.

The first section would be a semi-ellipse 18 m. wide and 5 m. deep on a 7-mm. grade. It would allow for the passage of 267.875 cu.m. per second of flood waters. The conduits would be so designed as to care for 250 cu.m. per second and the open channel comprising the third section 253.9 cu.m. per second. This last section would be 14 m. by 4 m. deep and on a 2-mm. grade.

The proponent of this plan does not underestimate the probable difficulty of securing power from the Paris district to run the centrifugal pumps during flood season. It is estimated that 115,000 hp. would be required running all the time for about 25 days, the average time of flood danger. The fact is recognized that the consumption of this amount of power would exert a considerable strain on industries in the Paris district, yet it is believed that the low factor for manufacturing would be more than offset by the advantages in knowing that the Paris district would be free from flood danger.

Cost of the entire works is estimated at 285,000,000 francs for the works alone, plus 7,500,000 for the cost of electric power necessary to run the pumps over a period of 25 days. The power charge is based on 25 centimes a kilowatt-hour.

As an indication of how much water the Seine and Marne carried during the winter just ended, the following figures are cited as to volume of water penetrating the soil of the Paris region per square kilometer:



VICINITY MAP OF PARIS AND PROFILE OF PROPOSED DIVERSION CHANNEL

	Cu. M.		Cu. M.
1920	83,000	1923	126,000
1921	40,000	1924	107,000
1922	120,000	1925	153,000

The volume thus, during 1925, was almost double the normal amount. Rainfall for the same year was:

	Mm.		Mm.
1920	530	1923	746
1921	283	1924	673
1922	730	1925	773

The normal rainfall is about 515 mm.

Proponents of this plan estimate that the diversion works would carry flood waters to the amount of 21,000,000 cu.m. per 24 hours. This would easily keep the Seine in check.

Carbon-Resistance Strain Gages Used

A carbon-resistance strain gage closely similar to the McCollum-Peters telemeter strain gage developed at the Bureau of Standards has been designed and built in Germany, according to an article by Dr. Siemann in V.D.I. of April 17, p. 539. The author states that he had experimented with the carbon-resistance method of measuring length changes some years ago, but abandoned it on account of lack of success and insufficient funds, and took it up again only after learning of successful application of the principle in America. Trials of the instrument were made on two ships at sea last fall, and finally actual stress measurments in a seaway were made recently during a trans-Atlantic voyage of the "Westphalia." An oscillograph was used to record the current indications. The particular instrument used had six current-carrying loops, permitting the recording of six strain gages at once. An arrangement has been devised in which, by use of a rotary switch or permutator connecting the recording circuit successively with the circuits of the several strain gages, it is possible to obtain on a single record readings of a number of strain gages.

Alteration Involving a 26-Story Self-sustaining Wall

Three Stories of Wall Removed and Load Above Transferred to Steel Frame—Deflection Wedged into Steelwork

By David C. Coyle
Structural Engineer, Gunvald Aus Co., Consulting Engineers, New York

THE MOST difficult engineering problems are frequently encountered when old buildings are adapted to modern tenancy, however little the visible results may show the ingenuity which was required on the part of the engineers and contractors. A unique problem confronted the owners of the Commercial Cable Building recently when they planned to provide new floor space for a tenant.

The Problem—The building, now 30 years old, is known as 20 Broad St. and goes through the block to 20 New St. Twenty years ago there was added what is called "The Annex," on New St. and Exchange Place, and it was connected to 20 Broad St. up to the fourth floor level, above which a 30-ft. court separated the two buildings. The problem was to floor over this court for three floors more.

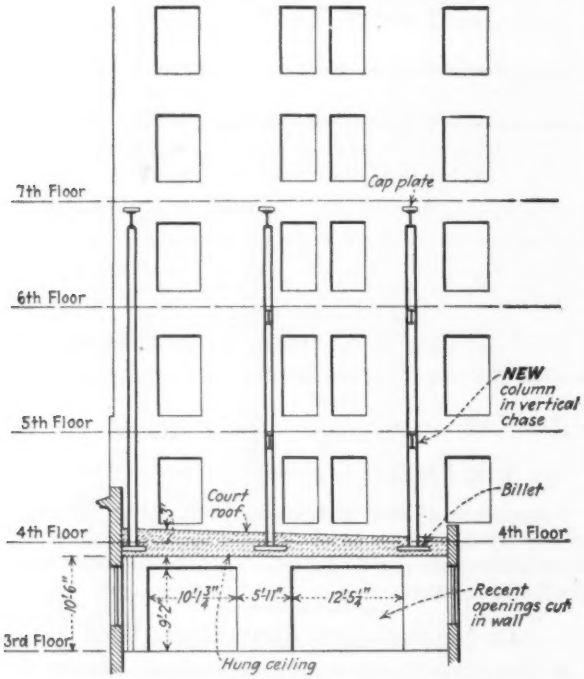


FIG. 1—COURT WALL OF 20 BROAD ST.
Heavy lines indicate new columns placed to carry wall load above. Wall from third to seventh floors removed after transfer of load.

The court wall of the old building is 22 stories high above curb and goes down through four basements; is of common brick, hard quality, laid in Dyckerhoff cement, and is self-supporting for its full height but anchored to the floor framing at each floor level. The floors are carried on Phoenix columns set on the inside of the wall, while on the other hand the Annex is of channel-box column construction with masonry walls carried on spandrel beams at each floor level. The new tenant required uninterrupted floor space on the fourth, fifth and sixth floors over the combined areas of both buildings and the court, which necessitated the removal of masonry walls. Removal of the self-supporting court wall of 20 Broad St. from the fourth to the seventh floor called for a unique method of transferring the wall above seventh-floor level to a new steel structure in the former court.

The seriousness of this undertaking can best be understood when the physical conditions are visualized. The seventh floor level is approximately 140 ft. above the lowest basement. In the third story wall large openings had previously been cut, leaving a series of three brick piers averaging 5 ft. x 2 ft. 8 in., each carrying approximately 500 tons (see Fig. 1). Now that the new work has been completed, the removal of three stories of wall has increased the factor of safety in those piers, which was very desirable.

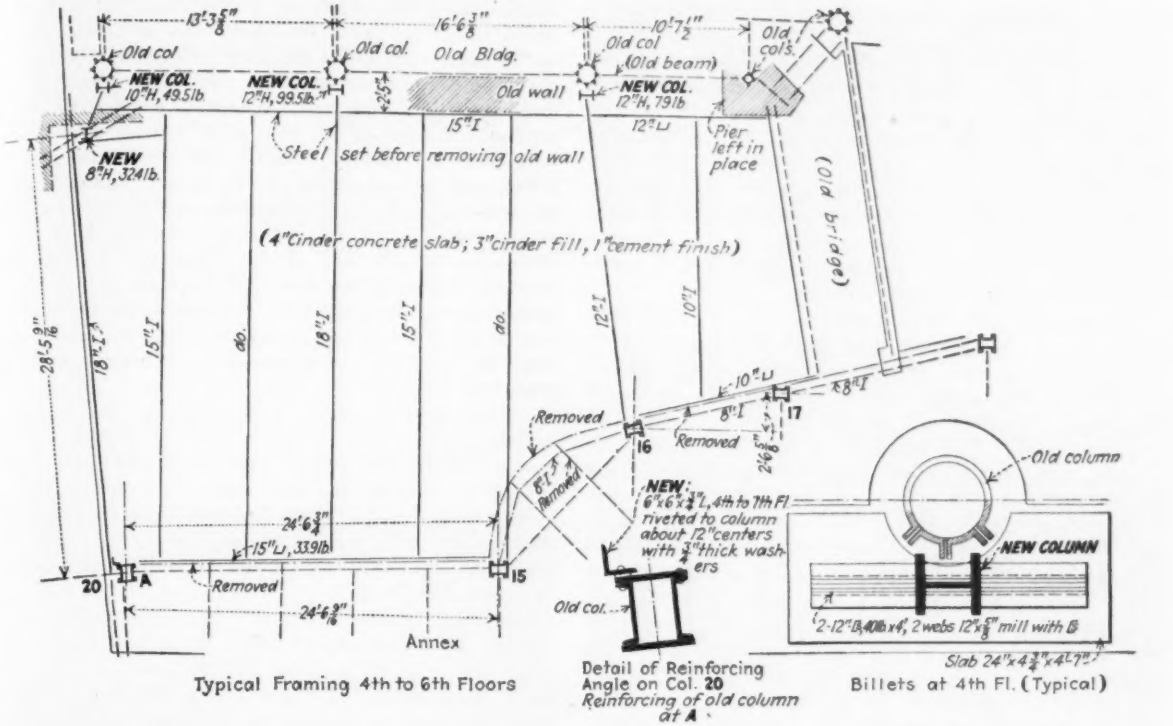
The function of the engineers in such a case is twofold; first, to be sure that the loads at all stages of the operation are properly supported, and, second, to make plain to the owners that a contract such as this is no job for an amateur—the cost is about as pertinent as it is in the case of a major operation in a hospital. It was essntial that at every stage of the work there should be some one in charge who could recognize unexpected dangers and unlooked-for conditions, though no justification for this attitude can now be established because no accidents occurred. Not only construction accidents had to be eliminated, but provision had to be made against such contingencies as bomb explosions or earthquake. In fact a very pronounced earth tremor occurred as the work was in progress, but with no ill effect.

The really delicate problems connected with this work were the introduction of the three stories of steel in the old self-supporting court wall and the lowering of the court roof 10 in. to the level of the fourth floor.

General Method—The engineer's design provided for 5-in. billets to be set over each pier, H-columns erected on them, and on the tops of these columns 18x18-in. cap plates installed and keyed up, so as to carry as much as possible of the load of the wall on the columns; the new floor steel then to be placed, and the load of the wall transferred to cantilevers of the seventh-floor beams.

To get a clear floor space on the fourth floor required that the new column billets be installed over the piers below the finished floor level; manholes cut through the former court roof made this possible. Under this roof is a hung ceiling carrying all the international cables of the Commercial Cable Co., and below this again operates the delicate magnetic apparatus that makes it possible to transact our modern world-business, service which must go on uninterruptedly every minute of every day in the year. Any water, dirt or noise interference would have caused great financial loss to the owner, and the effects of dropping a steel beam or a few tons of brick through this ceiling are more easily imagined than calculated.

The entire support of the wall had to be cut away at the tops of the piers between the fourth floor and the hung ceiling of the third story to install the billets. The sequence of operations was to shore the wall openings in the third to sixth stories (to produce conditions that would prevail if there were no openings in the wall in these four stories), and then install a temporary ceiling of sufficient strength to act as a scaffold under



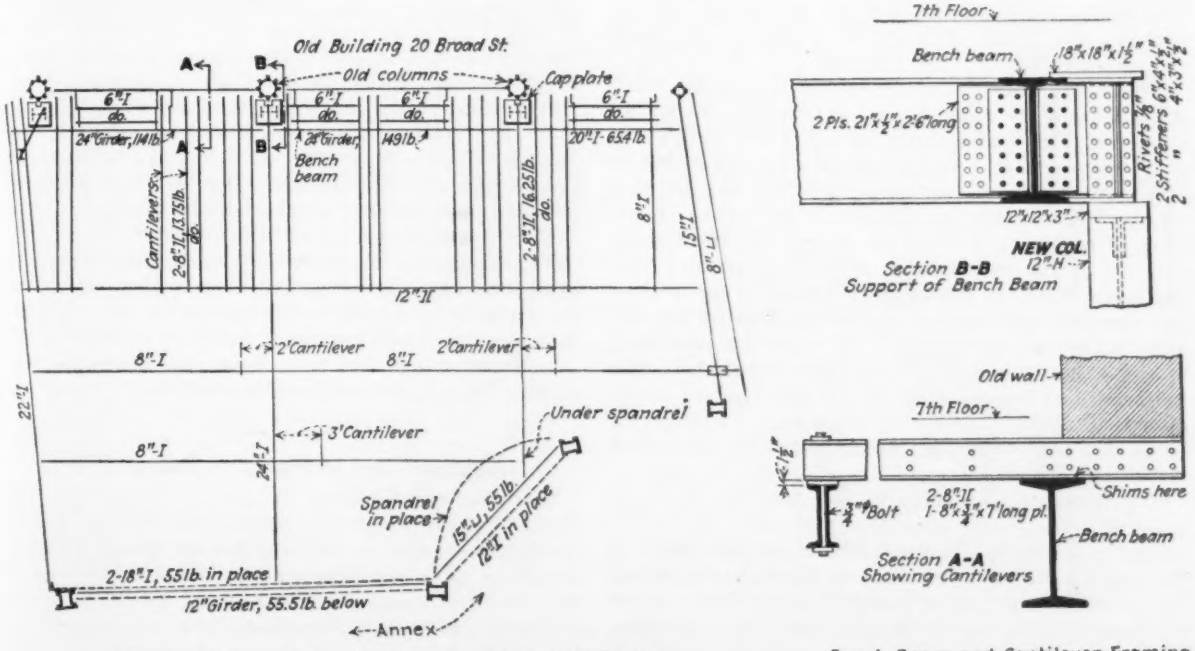


FIG. 2—BEAM FRAMING AND CANTILEVERS TO CARRY WALL

the ceiling of the third story. This temporary ceiling was covered on the bottom surface with sound-and weather-insulating materials to insure the continued operation of the owner's cables against noise or dust. Holes were thereupon cut in the roof and the furred ceiling at the places where the billets were to be installed. These holes were bulkheaded with waterproof cement on the roof, and flashings were built on the wall side over removable decks arranged for access when weather permitted. Cable supports had to be shifted and the cables boxed and covered with dry sand so that the sparks from the oxyacetylene burners would not injure the cables.

The holes for the billets were cut after the billets were placed alongside ready to set. The work on one billet was completed before another was started. Cutting was done with electric tools to neat size of billet, in a space only 12 in. high. The billets were grouted in quick-hardening alumina cement, and then the entire cutting was filled with brickwork. The work on each

pier in connection with the setting of the billet consumed about three days.

After all the billets had been installed, chases were cut for the first lengths of column; as soon as each was set, the chase was closed with brickwork and solidly grouted, to ensure positive strength at the pier heads as well as to prevent the possibility of any water getting in. It only remained to continue the chases up to seventh-floor level and install the remaining lengths of column and the floorbeams required to stiffen them. The cap plate in each case was thoroughly wedged and keyed up as soon as each column was set.

Transferring the Wall Load—At this stage of the work a great deal of the load above the seventh floor had been transferred to the columns, but because of the lack of foundation it was not possible to needle the spandrel sections and set the supporting steel as in ordinary work. The bench steel now placed for this purpose consisted of 24-in. Bethlehem girders running parallel to the court wall at the seventh floor, let into shallow chases in the side of the wall and supported on 24-in. beams spanning the court. The bench beams in turn supported small cantilevers, each consisting of a pair of 8-in. channels and a ⅞-in. plate between (see plan and elevation in Fig. 2). Each wall cantilever was supported at a predetermined height above the anchor beam—a pair of 12-in. channels located toward the center of the span. As the openings in the supported wall were not symmetrically located with reference to the pier lines it was not safe to consider that the masonry would arch itself and thus transfer practically the entire wall load to the columns.

Thereafter it was necessary to develop the theoretical deflections in the bench beams, cantilevers and anchor channels. This was done by the use of very thin plates of furniture steel. All the cantilevers except one in each section were drawn down tight and the one that was not drawn down was wedged in the opposite direction, thus opening a slight crack over the bench beam into which was inserted one of the steel plates. This cantilever was then drawn down tightly to the anchorage channels, and another cantilever released and the same procedure carried out. The process continued until the thoretical deflections were approximated. The uniformity of the deflection curves was positive assurance that there could be no settlement. Finally the entire masonry walls in the fourth, fifth and sixth stories were removed.

It is interesting to note that in demolishing these walls there was found a rupture line easily discernible by the presence of shattered bricks on the inside of the wall directly over the ends of the lintels spanning the openings that had a year previously been cut in the third story masonry. This was especially noticeable in the bay where the openings in the supported wall were unsymmetrical with reference to the pier lines. It fully illustrated the necessity of developing the deflection of any steel introduced when it is required to support loads of masonry.

Absolute assurance against accidents or failure was the prime necessity in this work; and the above-described procedure eliminated all the hazards due to the customary forms of shoring, needling and derrick installation.

Reinforcing a Column—The channel box type of columns in the Annex walls had been figured for 12,000 lb. maximum stress. Removal of the walls so nearly compensated for the added floor load that the columns could easily carry the slight increase with safety, except in the case of one corner court column on the New St. end, which had to be reinforced with a 6x6x¾-in. angle, without cutting off all the rivet heads in one gage line. This was done by cutting out rivets about 12 in. apart, and drilling a few new holes near the ends, then using ¾-in. washers to offset the angle outside of the remaining rivets (see sketch in Fig. 2). It was not necessary to consider stress difference between the loaded column and the new angle because the extra load above was set directly upon the angle and transferred gradually by rivets to the column, while the added stiffness due to the angle rendered the column able to assume the load.

At the seventh floor of the Annex, the spandrels had to be reinforced to take the new roof loads. There was a cantilevered curved bay, which was left undisturbed by passing the new floor steel underneath it. It may be noted in passing that the tenants on the third floor as well as those on the seventh of both buildings could not be and were not disturbed during the construction operation.

Lowering the old court roof was done after added stories had been enclosed. The occupancy of the third story prevented the removal of the furred ceiling which was hung to the roof beams which had to be lowered. Long bolts with a hook at the bottom end were hooked under the main furring bars of the furred ceiling and the other end passed through the new fifth floor court construction and secured with a washer and nut. When the bolts were all adjusted to an equal tension the furred ceiling was cut loose from the roof framing, then the framing was lowered without affecting the furred ceiling. After the new concrete slab which formed the fourth floor had been installed the bolts had only to be secured to this slab and the tops cut off.

The alteration presented what seemed like impossible problems for the general contractor, but the entire procedure was worked out by them and approved by the engineer before any work was started. The general contractor was Dall-Hayden-Treat, Inc., of New York. The Gunvald Aus Co., New York, was consulting engineer. Post & McCord were the steel contractors.

Mexican Line of Southern Pacific Ry.

Work on the Southern Pacific line along the west coast of Mexico, to give communication with the city of Mexico, is expected to be completed by the end of 1926, according to the company's annual report. At present the line is in operation from Nogales, on the frontier, to Tepic, and from La Quemada to a connection with the National Railways of Mexico at Guadalajara. On the 102¾ mile gap between Tepic and La Quemada, 64¾ miles of track were laid last year, making a total of nearly 82 miles. On the 21 miles remaining, grading had been completed for seven miles at the end of 1925 and was in progress for 9½ miles. Unexpected formation encountered in the tunnels has made it necessary to increase the amount of concrete lining, while slides have occurred during the rainy season. Both of these difficulties have delayed the work, but the report states that the line should be completed and ballasted by next January.

Lining An Earth Spillway Channel with Concrete

Spillway Channel Through Clay for Alouette Dam Exceptionally Carefully Lined to Prevent Scour

By C. E. Blee
Principal Assistant Engineer, Construction Department, British Columbia Electric Railway Co., Ltd.

Weir construction and concrete paving and lining for the spillway for the Alouette dam (*Engineering News-Record*, April 29, 1926, p. 696) developed several devices for handling concrete which possess interest. The weir and gate entrance from the reservoir to the spillway are shown by Fig. 1. Thence a trapezoidal channel extends down the stream bank and ends in a cutoff or toe wall, and a boulder mattress. A view of the channel portion is given by Fig. 2.

FIG. 1—WEIR SECTION OF SPILLWAY FOR ALOUETTE DAM
Note under-sluice gates and gate operating car. These gates are for augmenting low-water flow only and are not used when water is spilling over the weir.

About 8,000 cu.yd. of concrete was used, the greater part of this being in linings 6 to 15 in. in thickness in the spillway cut. The concrete aggregate was obtained from the gravel bank that supplied material for the gravel facing. The total crew on the washing, screening and mixing plant, with a normal capacity of 100 cu.yd. per shift, amounted to seven men, three on the washing and screening plant, one on the hoist, and three on the mixing plant.

The mixing plant was centrally located on the bank at the edge of the spillway excavation, near the west edge of the dam. Concrete was delivered over a narrow-gage track in a ½-cu.yd. car on which a Ford automobile engine had been mounted. The track was carried out over the spillway on light trestle at sufficient elevation to permit pouring the side linings directly from the car. This trestle, Fig. 2, was set on pipe rollers so that it could be shifted quite readily and in this way all the concrete for the job was spouted directly from the car into place.

The side linings of the spillway were on a 1:1 slope, for the most part 14 ft. high. As a means of holding down the forms against the uplift of the concrete on this slope, concrete ribs spaced 14 ft. 3 in., center to center, were first poured and allowed to set and then the forms for the lining were anchored to them. The ribs were of inverted T-section, 12 in. deep and 14 in. wide, including a 2-in. shoulder on either side to receive the slab forming the lining. The lining slab was 12 in. thick at the bottom decreasing to 9 in. at the top while the rib was 12 in. deep throughout. Expansion joints were placed at alternate ribs.

FIG. 2—MAIN SPILLWAY CHANNEL, ALOUETTE DAM
Looking downstream and showing car and trestle used for distributing concrete. Note log way at lift of main channel.

The forms for the lining, Fig. 3, consisted of 2 x 12-in. horizontal lagging, long enough to span the space between adjoining ribs, supported by 2 x 6-in. vertical studs. These studs in turn were held down by trussed-timbers spanning from rib to rib and held by ⅝-in. anchor bolts previously embedded in the concrete ribs. The forms were limited to 5-ft. lifts in order to facilitate the placing and rodding of the concrete.

The spillway floor, 9 in. thick, was poured in alternate blocks about 20 x 30 ft. in size. Expansion joints consisting of ½-in. sheets of asphalt and asbestos fiber compound were placed between blocks. Both side and bottom linings were reinforced with 6 x 6-in. No. 5 welded wire mesh, the reinforcement being carried through the expansion joints.

The drop of the water from the spillway level down to the stream bed, a distance of about 38 ft., was accomplished by an ogee section at the end of the spillway. The excavation was shaped to the required form

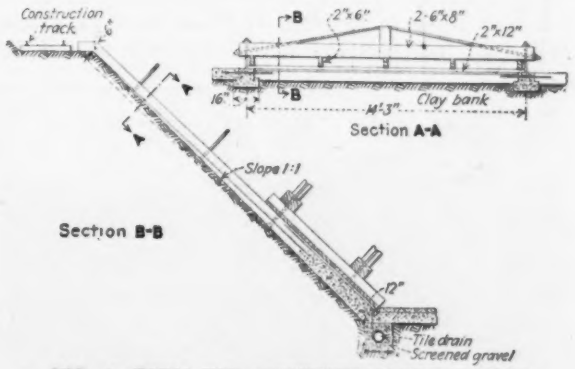


FIG. 3—FORM FOR CONCRETE SLOPE PAVING SPILLWAY SIDES

and a reinforced-concrete covering, consisting of longitudinal and transverse ribs with a 15-in. slab, was placed directly on the excavated surface of the clay.

The safeguarding of the foot of the ogee structure against erosion was something of a problem since, at the lower levels, the capping of hard clay had been cut through and the material encountered was a mixture of fine sand and clay—a material very susceptible to erosion. The flat discharge section at the end of the ogee structure was depressed below the river bed so that at all stages of discharge the backwater would form a pool of sufficient depth to induce an hydraulic jump. This was relied upon to dissipate to a considerable extent destructive water velocities. Then at the lower end a concrete cutoff toe wall 5 to 7 ft. in thickness was carried to depths of 12 to 15 ft. below the ogee floor. This toe wall was also carried back under each side of

the ogee, a distance of 19 ft. thus forming a deeply founded, U-shaped spigot protecting the entire end of the ogee structure.

As a further protective measure, a flexible mattress, 40 ft. in length and flaring from 120 to 145 ft. in width, was placed beyond the toe wall. This mattress was formed of very large boulders—specified to have a minimum dimension of not less than 3 ft. Eyebolts were anchored in the top of each boulder and all were securely tied together with longitudinal and transverse cables intersecting over the eyebolts and clamped thereto. Over the tops of the boulders was poured a 12-in. slab of concrete. Beyond the mattress a loose riprap of heavy boulders was placed along the slopes leading to the streambed level. At the sides steel sheetpiling was driven to afford temporary protection against undercutting.

The design and supervision of all work in connection with the Alouette development is under the direction of E. E. Carpenter, consulting engineer of the British Columbia Electric Railway Co., Ltd. The contractors handling the construction of the Alouette dam are Pacific Engineers, Ltd., C. A. Strong, general manager, and C. A. Kallman, superintendent.

Arch Dam of Thin Section Now in Service on Salt River

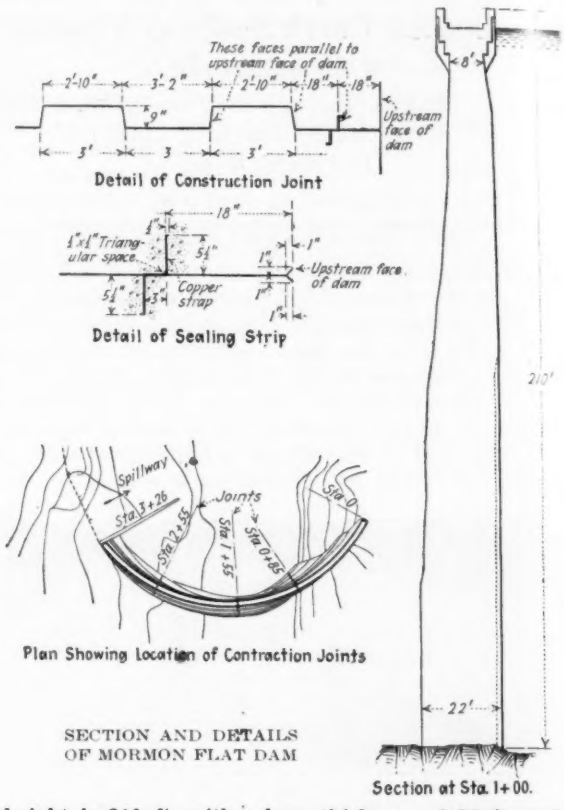
Mormon Flat Storage Dam on Salt River Project Has Base 22 Ft. Thick and Height of 210 Ft., Arched on 181-Ft. Radius

THE Mormon Flat dam, completed last year on the Salt River in Arizona, 27 miles below the Roosevelt dam, increases the storage capacity of the Salt

MORMON FLAT DAM ON THE SALT RIVER PROJECT

River irrigation project by 90,000 acre-ft. and makes possible the development of 20,000 hp. A 10,000-hp. reaction turbine was included in the initial installation and another 10,000-hp. unit is to be added at a later date. The head on this plant will vary from 70 to 150 ft. and the turbine was designed for maximum efficiency under these conditions.

The dam was designed by the cylinder formula and stresses were calculated according to the theory of the elastic arch. Its section is shown in the drawing. The



SECTION AND DETAILS OF MORMON FLAT DAM

height is 210 ft. with a base thickness of 22 ft. and a thickness under the roadway on the crest of 8 ft. The crest length is 326 ft., exclusive of the overflow gravity section which is 90 ft. long with a maximum height of 93 ft. A total of 43,000 cu.yd. of concrete was used in the structure.

The spillway is located on the gravity section of the dam and on left bank immediately adjoining. It has a capacity of 150,000 sec.-ft. Closure of the spillway is effected by the use of nine Taintor gates, 27 ft. long and 23 ft. high. These gates weigh 27 tons each and are operated by a 10-hp. motor mounted on a truck which enables it move along the crest of the dam from gate to gate.

The motor is supplied with current from wires led through the hand rail on the bridge as a conduit, with outlet plugs at convenient intervals. Connection between the motor drive and the gate-operating mechanism is effected by the insertion of a square shaft driven by the motor into a socket flush with the concrete walkway on top of the dam.

Three vertical construction joints were used in this dam. These joints were made watertight by 14-gage annealed copper sealing strips, 15 in. wide. The portion of this strip, 3 in. wide, which is in the plane of the joint, was painted with asphalt on both sides. A further refinement in the design of this sealing strip was to allow a ½ x ½-in. triangular space at an angle at which any expansion of the metal might be taken up without damage to the strip.

The dam was designed and constructed by the Salt River Valley Water Users Association under the direction of C. C. Cragin, general manager and chief engineer. F. J. O'Hara was assistant chief engineer; P. J. Lynch was in charge of the construction department and Clark Miller was construction superintendent.

Corrosion in an Old Viaduct at Joints and in Concrete-Incased Steel

By A. R. Ellis

General Manager, Pittsburgh Testing Laboratory, Pittsburgh, Pa.

An instructive example of corrosion conditions in an old steel viaduct in western Pennsylvania came to the writer's notice recently when the public authorities requested an examination of the viaduct to determine its condition and the need for repair. The structure dated from the horse-and-buggy days, having been built thirty-five years ago. It consisted of 15 spans ranging from 20 to 60 ft., generally latticed trusses supported on steel bents grouped in pairs to form towers, with 75 ft. maximum height from ground to roadway. Up to a year ago the structure had been open to all traffic, and was used even for heavy trucking, but later it was closed to all but pedestrian traffic. The examination referred to showed that it was practically beyond repair, as at best it would have been a patched job and suitable for only medium-weight traffic. The structure was therefore dismantled.

The following may be noted among the specially serious points of corrosion: The bottom chords of the trusses, made up of two angles and a cover plate, formed pockets which held water, the resulting corrosion had partly destroyed the chords, the cover plates being rusted through at many places. Lateral and sway bracing angles were placed with outstanding legs pointing up instead of down, and water and dirt accumulating on the ledges so formed, drained down into the panel points and caused serious corrosion there. No provision had been made for proper drainage of the roadway, but the water was allowed to run along the curb gutters, whence it drained down between the curb block and the end of the roadway planks, falling on the top chord of the trusses. In many cases the outstanding legs of the top chord angles were completely rusted through.

Provision for expansion had been made originally at five points, but in the course of time the expansion joints had filled with rust, and it was doubtful if they had functioned for many years. Subsequent expansion of the structure as a whole had buckled many of the compression members, whose sectional areas had become considerably reduced by corrosion. In general, the trusses were not functioning as such but were acting as struts, with reversal of the normal tension in the lower chords and buckling of these members at many points.

The bases of many of the supporting columns and some of the bottom struts connecting them had been incased in concrete, probably at a later date than the original construction. This incasement, however, was not only ineffective but defeated its own object, for the concrete was porous and absorbed water, holding it against the steel and actually promoting corrosion. Moreover, the tops of many of the concrete caps at the columns were flat or even concave, allowing water to accumulate and lie against the steel, further promoting corrosion. At these points some of the columns were almost rusted through.

Sections of all members were measured in the course of the examination, and net areas determined by removing the rust at the weakened points. The stress calculations made on the basis of these areas showed that under dead-load alone the steel in many of the main members was stressed well beyond its elastic limit, in both compression and tension members. Yet the viaduct was in almost perfect alignment, though it was easily set vibrating, even by a child's bicycle, and it swayed appreciably in strong winds.

Because of the nature of the design, inviting corrosion of members and details, the structure was one which throughout its life should have had careful inspection and maintenance. These were not supplied, however, and according to the best evidence that could be obtained the bridge had been painted only twice during its life. Had it had proper attention and maintenance the bridge might still be in service, at least for light traffic. As it is, the taxpayers of the borough will be under a heavy burden to replace it.

Tests of Vibrolithic Concrete

The Bureau of Public Roads, co-operating with the American Vibrolithic Corporation, has recently completed 28-day tests on concrete slabs constructed of the same materials in accordance with ordinary methods of the Vibrolithic process patented by the company.

The tests were made for the purpose of obtaining data on the relative strength of specimens equivalent in every particular except the method of construction. To that end every effort was made to eliminate all variables except the methods of placing, tamping, and finishing, and to have all operations performed under as nearly similar working conditions as possible.

Although it is recognized that the ultimate problem is one of economy, the current investigations have been confined to the study of certain physical properties of slabs made by the two methods; among them, the tensile strength as determined by bending, density, coefficient of expansion, and uniformity of the product.

The program of tests includes, in addition to those which have been made at the end of 28 days, others that will be made after one year; and the formulation of definite conclusions must await the completion of the latter tests. There are certain indications, however, which may be noted at this time with the understanding that they may be modified by the data obtained from the remaining tests.

Giving due consideration to all features of the investigation, such as the workability of the concrete and the method of finishing the normal specimens, the following tentative conclusions may be drawn from the bending tests at the age of 28 days.

1. The Vibrolithic process resulted in a more uniform product.
2. For a given cement content, the slabs constructed by the Vibrolithic method exhibited greater strength than the normal concrete.
3. The strength of the slabs constructed by the Vibrolithic process, when tested with tension in the bottom, was practically the same as when tested with tension in the top.
4. The strength of the normal concrete, when tested with tension in the bottom, was less than when tested with tension in the top.

Full details of the 28-day tests are reported in *Public Roads* for April, 1926, by L. W. Teller, engineer of tests. The above is an excerpt from the report.

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Cost of Traffic Line Marking with Marker Built on the Job

ASPHALT-MARKED traffic lines are being marked at less than $9 a mile by the home-made marker shown in the accompanying view and designed by foreman Hugh Henry of the Santa Ana district of the California State Highway Department. Using 30 gal. of oil per mile and on the basis of marking eight miles a day the cost items are given as follows:

	Total	Per Mile
Labor—foreman and 5 men	$26.27	$3.28
Truck rental and gas and oil	7.50	.94
Material—30 gal. 95% asphaltic road oil		2.85
Total		$7.07
If additional light truck is used to protect line and act as supply truck, add		1.81
Total cost		$8.88

These costs are based on a force consisting of a foreman with five men (sixth man needed in case extra truck is used), this force being distributed as follows: Foreman following marker device, watching line critically and supervising oil feed; 1 laborer guiding flange wheel; 1 truck driver driving truck; 1 laborer at oil pot pumping; 1 laborer ahead with bar opening up and cleaning a shallow groove at the edge of the pavement, and 1 laborer brooming off the pavement and groove.

TRAFFIC LINE MARKER BUILT FOR $35

The marker, built of materials on the job at a cost of $35, is shown by the accompanying view. As indicated a light steel frame on wheels carrying a spray box is fastened to the rear of a truck in such a way as to have a certain amount of lateral play. The centering of the spray box is accomplished by the two outside wheels held against the pavement edge by the U-handle. The truck carries the oil heater which feeds to the spray box through a hose. The spray box is the particular feature. It is a four-sided box open top and bottom. The box is 5½ in. wide, inside measure, by 8 in. high by 6 in. long, and made of ¼-in. metal. Fitting loosely over the bottom of the spray box is the spray box runner made of two steel plates, ½ in. thick, by 15 in. long, by 3 in. high, bolted loosely together with two ⅝ in. x 8-in. bolts, spaced approximately 6 in. on centers. This spray box runner slides up and down freely, so that in its vertical position the runner is independent of the spray box, but its horizontal position is fixed. The runners are, therefore, always resting on the pavement exactly below the spray box. This prevents the asphalt from spraying beyond the limits of the runner. By bending in the rear of the two runner plates, any excess of asphalt dropping down from the plates is spread back on the line.

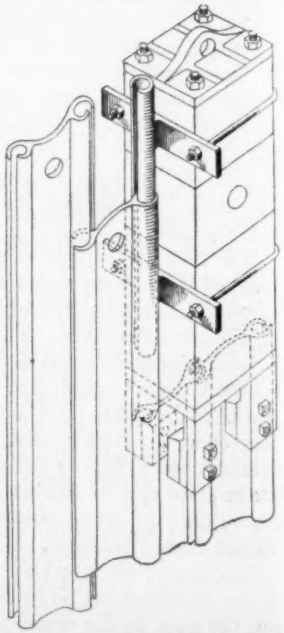
An ordinary oil spray nozzle proved too large and a special nozzle was designed with a $\frac{5}{32}$-in. opening. Over this, with openings nearly matching, is placed a ¼-in. cut washer, with a sloping trapezoidal cut, flaring from a width of $\frac{5}{32}$ in. at the front to approximately $\frac{3}{16}$ in. at the back. On top, acting as a lip or baffle plate, is fastened a ½x¾-in. washer about ⅛ in. thick. These are assembled with a ¼-in. cap screw. Installed in the line back of the special nozzle is a ½-in. pipe cut-off valve.

Sliding Attachment Guides Steam Hammer While Driving Steel Sheeting

BY R. J. REIGELUTH
C. W. Blakeslee & Sons, New Haven, Conn.

A NOVEL steam hammer attachment for driving steel sheeting was recently used on construction work at the Steel Point Power Plant, Bridgeport, Conn. In order to build a cofferdam in quicksand for a 339-ft. intake tunnel, an intake well and a discharge tunnel, it was necessary to drive 860 tons of 40-ft. sheeting. It was evident, early in the work, that the usual methods of driving would have to be improved on account of the hard driving required to reach the necessary depth.

An attachment, designed and built on the job, provides a firm guide for the hammer by the use of a sliding connection that fits into the groove of the adjacent piece of sheeting. This arrangement has several advantages. It holds the hammer directly in line so that the full force of the blow is delivered to the lock of the two pieces which it is driving. In this way the tops are not badly broken. With this guide it is also possible to release the derrick so that it can place other pieces while the hammering is in progress, and it dispenses with the use of tag-line men.



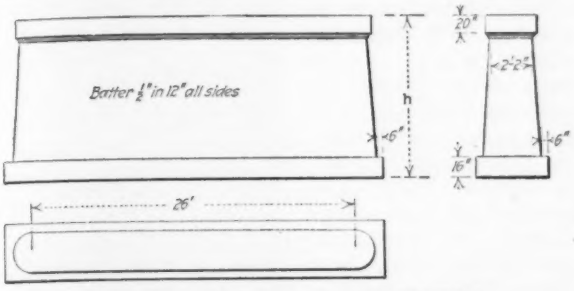
SLIDING GUIDE FOR STEAM HAMMER

The attachment was developed by C. W. Blakeslee & Sons, New Haven, Conn., the contractors, and proved so successful that it was patented by the designer.

Figuring Quantities by the Use of Higher Differences

By Arnold Escher
Department of Highways, Nashville, Tenn.

THE volume of a prism to be figured for different heights varying by a constant increment will be done most conveniently by figuring first one volume and adding the difference which corresponds to the increment, in this case a constant. It should be noted that a similar procedure may be followed for more complicated solids, where several dimensions vary in function of the height, as common in piers, bents, etc. In this case the difference of the volumes (first difference Δ_1) is no longer a constant, but the difference of the difference (second difference Δ_2) may be constant, or a higher difference. There will always be a constant difference of higher order as long as the volume can be expressed by a rational algebraic function of the variable dimension. If there are portions not following such a law, or any analytic law at all, they may be treated separately.



PIER DETAILS USED IN COMPUTATION

The following is an example of the practical application of this method for figuring the volume of a standard battered mass concrete pier for heights varying by 1 ft. from 10 ft. to 40 ft.

It will be noted that the whole work may be done without any knowledge of higher mathematics. The first four volumes are figured, then by subtracting each preceding value from the following the first differences are formed and likewise the second and the third, the figures above the zigzag line. The constant Δ_3 may be checked easily by writing down the equation for the part that varies with the third power of the height, in our example the nose, and differentiating three times. This may be of advantage, as the slightest error in figuring the volumes or differences will increase considerably through the repeated subtraction. It may be shown that any error d of the third difference appears in the last volume to the extent of

$$\frac{n}{\Sigma\Sigma\Sigma d} = \frac{n(n+1)(n+2)}{6} = \frac{27 \times 28 \times 29}{6} = 3{,}654 \text{ times.}$$

If therefore an error of 0.01 is allowable in the final result the third difference is to be carried to

$$\frac{0.01}{3654} = 0.000003$$

or six places after the point should be considered.

After one set of differences is figured above the zigzag line, the building up of the following volumes is self evident, and it will take less than 30 minutes to figure the rest of the 30 piers.

First the constant Δ_3 is taken into the adding machine and added to each preceding value Δ_2, thus forming the Δ_2 column, then add to each Δ_1 the following Δ_2, and afterwards to each volume the following Δ_1, which will complete the V volume.

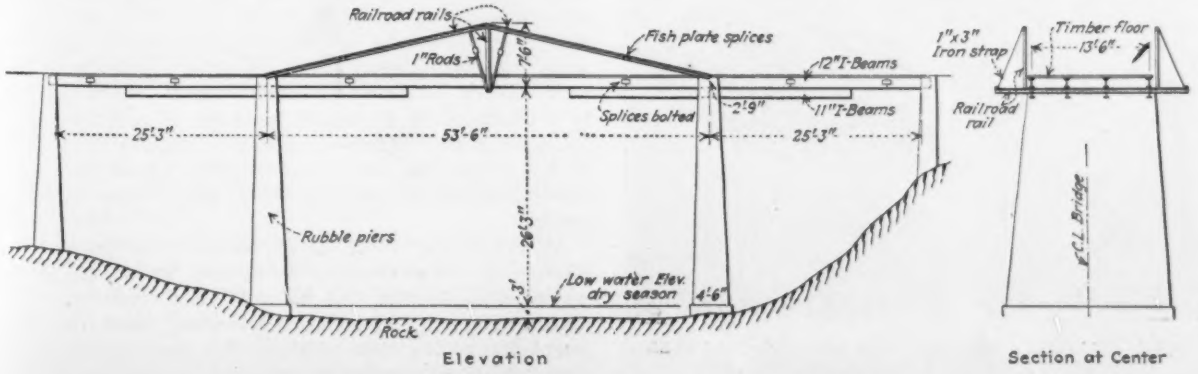
TABLE—METHOD OF COMPUTATION

h	V	Δ_1	Δ_2	Δ_3
10	28.350548			
11	31.403742	3.053194		
12	34.551604	3.147862	0.094668	
13	37.794538	3.242934	0.095072	0.000404
		3.338	0.0955	
14	41.13	3.434	959	
15	44.57	3.531	963	
16	48.10	3.627	967	
17	51.72	3.724	971	
18	55.45	3.822	975	
19	59.27	3.920	979	
20	63.19	4.018	983	
21	67.21	4.117	987	
22	71.32	4.216	991	
23	75.54	4.315	995	
24	79.86	4.415	999	0.000404 const.
25	84.27	4.516	0.1003	
26	88.79	4.616	007	
27	93.40	4.717	011	
28	98.12	4.819	015	
29	102.94	4.921	019	
30	107.86	5.023	023	
31	112.88	5.126	027	
32	118.01	5.229	032	
33	123.24	5.333	036	
34	128.57	5.437	040	
35	134.01	5.541	044	
36	139.55	5.646	048	
37	145.19	5.751	052	
38	150.94	5.856	056	
39	156.80	5.963	060	
40	162.77			

An Ingenious Highway Bridge in Panama

By George L. Knott
Consulting Engineer, Queen's Village, Long Island

NEAR La Chorreha in the republic of Panama is located an odd variety of highway bridge which shows how it is sometimes possible to build a most serviceable structure with nothing more than the mate-



SKETCH OF HIGHWAY BRIDGE NEAR LA CHORREHA, PANAMA

rials at hand. This bridge is a combined cantilever and simple truss of steel I-beams and rails of European make. Apparently these materials were meant for the original canal project of the French.

There are four 11-in. cantilever I-beams running longitudinally across the piers and supporting continuous stringer systems of 12-in. I-beams. The ends of the cantilever beams are bolted to the stringers by means of four bolts through the flanges instead of the usual group of stitch bolts to make the lower beams act as stiffeners. The top chords and bottom center strut support are inverted heavy railroad rails. The U-rods of the truss are anchored through the top chords and held in place by nuts on the inside.

The bridge, which was still in good condition when the writer observed it in 1921, had withstood the rainy seasons for the past fifteen years. Stream elevation sometimes varied the entire 26 ft. between the lower edge of the beams and the base of the piers.

To have utilized these old materials in the construction of such a bridge for light traffic is indeed an ingenious piece of work. The engineer in the tropics must learn to use all materials at hand instead of waiting, perhaps many months, for the proper materials to be shipped to the site.

Traveler Templet for Erecting Sewer Reinforcing Steel

UTILIZING the idea behind the design of movable and adjustable forms for concreting sewers and tunnels, one of the contractors on the 15-mile Blue River sewer now under construction in Kanses City, Mo., has devised a templet for the accurate and rapid erection of the reinforcing steel.

FIG. 1—TRAVELER TEMPLET FOR REINFORCING STEEL ON BLUE RIVER SEWER, KANSAS CITY, MO.
Note transverse rods near bottom holding hinged ends of heavy arch members in place.

The sewer on this particular part of the line is of an arch section 21 ft. wide and 16 ft. high. The templet is used to erect the arch steel, the invert steel having been previously placed and concreted in. The templets are made in sections 12 ft. long mounted on steel wheels running on the invert. The heavy arch members of the templet are built up from properly shaped segments of 1x12-in. boards. The stringer members are 2x4's to which are nailed a 1-in. strip properly grooved for receiving the reinforcing steel. Collapsibility and adjustment of the templet are obtained by screw jacks bearing on the invert. In order to permit the templet to drop down below the steel so that it may be moved ahead the heavy arch members are hinged about 3 ft. from the bottom. These hinged ends are held on the arch line by means of rods extending across the sewer wedging them outward. These rods may be seen in Fig. 1. The Forson Construction Co. of Kansas City, Kansas, has designed and is using these templets with the result shown in Fig. 2. Black & Veatch, Kansas City, Mo., are consulting engineers on the Blue River sewer.

FIG. 2—COMPLETED SECTION OF REINFORCING STEEL ERECTED WITH TRAVELER TEMPLET

From Job and Office

Hints that Cut Cost and Time

Experiences in Driving Piles Through Water-Bearing Sand

By L. M. King
Construction Engineer, Estuary Subway, Oakland, Calif.

IN DRIVING piles for the temporary support of the Southern Pacific R.R. over the Oakland approach of the estuary subway, now under construction, difficulty was experienced in driving the piles to the depth desired. At this location the open cut for the subway construction attains a depth of 65 ft. below base of rail. Heavy section steel sheetpiling had been driven to a depth of 70 ft. below the base of rail, or 5 ft. below subgrade. The wood piling to support the plate-girder bridge was driven immediately behind the steel sheetpiling and it was desired to drive them to subgrade.

At a depth of 40 ft. below base of rail there is a stratum of water-bearing sand, and when the piles reached this stratum they came to an abrupt stop. In continued driving of some of the piles under the adjacent tracks the sand stratum had been pierced and the piles had penetrated into the clay beneath until the desired support was obtained. In this case, however,

From Job and Office

For Contractor and Engineer

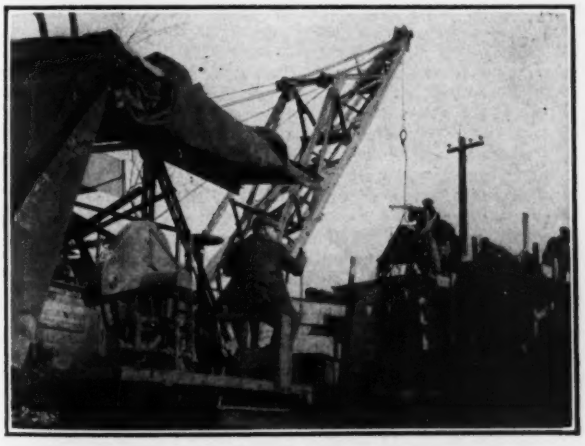
the piles could not be driven below this sand stratum. After continued driving of one of these piles from 10 a.m. until 12 m. it was thought that the pile was brooming at the tip and it was decided to pull it. The foreman protested that it would be impossible to pull the pile; but to his surprise, the pile popped out of the hole with the first strain of the runner line. Examination showed the pile to be in good condition, but the tip was steaming hot.

The pile was then replaced in the hole and driving continued, in the hope of penetrating the sand stratum into the clay bed beneath. Just before 5 p.m., after continuous driving all afternoon, as the hammer reached the top of the leads, the pile was suddenly blown out of the hole, followed by a cloud of steam and sand. Eleven feet of the pile tip were left in the hole and examination of the broken pile showed the fiber to be crushed and steaming hot with the strong characteristic odor of charred wood. Presumably, the continued driving and friction of the pile in the wet sand had generated so much heat that steam formed in sufficient quantity to blow the pile out of the hole.

Concrete Buggy Converted to Bucket for Handling by Crane

By James H. Elkins
Manager, Steel Construction Co., Birmingham, Ala.

TO OBVIATE construction of expensive equipment that would have been necessary had a tower and chuting been used, the contractor on a building job at Birmingham, Ala., devised the method of concreting



CONCRETE BUGGY HANDLED BY CRANE FOR CONCRETING BUILDING WALLS

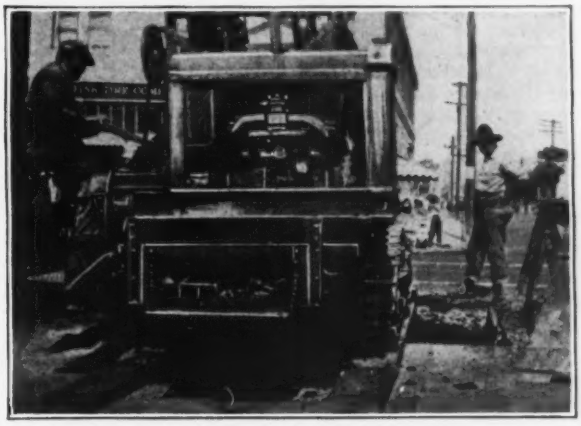
the walls of the new plant for the Ingalls Iron Works Co. herein shown.

The wheels of a concrete buggy were replaced by shackles and attached to the fall line of a steel boom crane with crawler mounting which had been originally purchased for steel erection. The mixer was located behind the crane close to the aggregate storage piles. The crane also unloaded the aggregates from cars with a ¾-yd. clamshell.

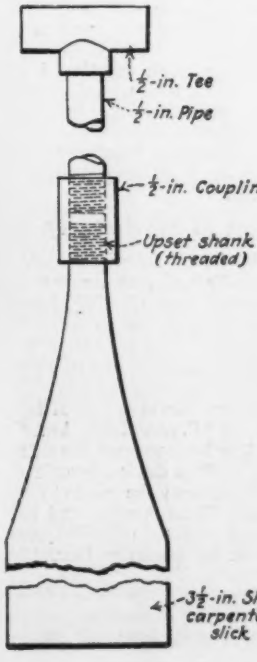
The work was done by the Steel Construction Co. of Birmingham, Ala.

Job and Office Notes

Other Uses Than Trenching have been discovered for the Barber-Greene ditcher by a contractor in California who is doing some work for the Pacific Gas & Electric Co. The photograph herewith shows the ditcher digging a manhole 10x8 ft. and 5 ft. deep. The cut is indicated on the pavement with chalk and the pavement cut through to the subgrade. The position of supporting planks is also marked on the pavement and the planks put in position for the



first cut. The ditcher mounts the planks and the vertical boom digs to the desired depth with the conveyor discharging at its extreme extended length. When the first cut is made the boom is raised and the machine is backed clear of the planks, which latter are placed in position over the manhole for the next cut and so on, until the hole is half completed. With the hole half completed, the machine is turned end for end and digs from the opposite side of the manhole. This eliminates the necessity of changing the conveyor to fill the other side of the machine. The excavation herein shown (400 cu.yd.) was made in 48 min. with the ditcher. The contractor estimated that one man with a pick and shovel would average about 180 cu.ft. of this material in 8 hr. On that basis, the ditcher performed 17.7 man-hours labor in 48 min.



In "Measuring Glacial Movement of Mount Hood," *Engineering News-Record*, March 4, p. 456, mention is made of the difficulty of drilling holes in the ice. "We have drilled holes," writes J. E. Sears, assistant division engineer, Welland Ship Canal, Port Robinson, Ont., "through 15 ft. of ice with the tool herein described. This ice was often in many layers, some of which were in motion. We took an ordinary ship carpenter's slick (wood chisel) with a 3½-in. bit, and upset the shank. A ½-in. pipe thread was then cut on the shank and a coupling with a piece of ½-in. pipe and a ½-in. tee constituted the handle. It was then used as an ordinary churn drill with water in the hole. The handle can be made of variable length, as it is just ½-in. pipe.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Associations Promoting Engineering Betterment

Sir—In your issue of April 22, p. 663, are letters from officials of the Association of Engineers of New York and the Los Angeles Municipal Engineers Association.

From the tone of the letters it would seem these officials believe their organizations are starting something new in activities looking towards the welfare interests of the engineer, when in fact one national engineering organization has been working on the subject extensively eight years.

If these officials and their organizations are really interested in a national way in working for the social and economic betterment of the engineer it would pay them to get in touch with the American Association of Engineers of Chicago which has done more than any or all other engineering societies to benefit the engineer along the lines indicated in the letters of the officials.

The American Association of Engineers has compiled a great amount of data on services and salaries of engineers, has issued a book on how to secure publicity for the engineer and his work, and has published many reports on welfare plans for the advancement of the engineer. At the convention of the association to be held in Philadelphia June 14, 1926, there will be presented the most complete report ever prepared on services and salaries of engineers, the data being compiled from about one thousand engineering departments spread over the entire United States.

All the above information will be given gladly to anyone interested, and inasmuch as one society is performing this welfare work in such a competent manner why clutter up the field with local organizations desiring to expand to national proportions.

In the April issue of the *Professional Engineer* published by the association, under the article entitled How Is Your Salary Curve? it is said: "That there should be a national classification of technical, professional engineers, with standard specifications on work and pay which could apply to all kinds of positions in all states of the country is self-evident to those who have given any consideration to the subject. Such a classification will never be devised and put into effect until the engineers themselves get behind the project, and then perhaps some day we will have universal classification of engineering positions with pay commensurate with the duties performed."

The association already is doing the work mentioned by the New York and Los Angeles organizations, and stands ready at any time to assist local organizations in their welfare problems.

ARTHUR RICHARDS,
Planning Engineer,
City Plan Commission.

Altoona, Pa.,
April 22, 1926.

Slump Not Complete Test of Workability

Sir—I have just seen a letter by B. F. Jakobsen in the Jan. 28 issue of *Engineering News-Record* commenting on C. N. Conner's article on "Admixtures," Dec. 17, 1925, issue.

Mr. Jakobsen inquires as to how the tests on workability referred to by Mr. Conner were made. The writer is not familiar with the method used by Mr. Conner for measuring the workability of the concrete, but believes that the penetration method described by Messrs. Pearson and Hitchcock of the U. S. Bureau of Standards (*Proceedings*, American Concrete Institute, 1924) is the best means thus far developed for measuring workability. The device described, known as the penetration apparatus, may be said to be somewhat similar in principle to the Vicat needle, and the results to express the relative ease of rodding different concrete mixes. This seems to be a better measure than the slump or flow-table test. The slump or flow of a concrete mix is a function of the water content, or in other words of the consistency. Concrete containing diatomaceous silica as an admixture may be drier than a plain concrete of the same mix of cement and aggregate and still the former will be far more workable and more readily placed.

Mr. Jakobsen hits upon a very important point when he refers to certain tests with admixtures with which he states he is acquainted whereby an increase in strength was secured but a decrease in slump was shown. In other words the concrete containing the admixture was *drier* than the plain concrete. The important point is that such mixtures of admixture concrete have more workability than wetter plain concrete of the same proportions.

GEORGE A. SMITH,
Celite Products Co.

Los Angeles, Calif.,
April 14, 1926.

A Misleading Statement

Sir—The statement has appeared in a number of engineering periodicals that the use of a unit stress of 18,000 lb. per sq.in. instead of the 16,000 lb. commonly used "makes possible a saving of 12 per cent in the amount of steel needed for any given building." This statement is erroneous and for the good of both engineers and the buying public should be corrected. The purchaser of steel for "any given building" will be liable to disappointment if he finds that in his own particular building the reduction may hardly be the half of 12 per cent. Incidentally, the theoretical reduction of using 18,000 instead of 16,000 is 1/9th, or 11 1/9 per cent instead of 12 per cent.

Let us consider industrial buildings of the single-story mill type designed on a basis of 16,000 lb. They are often of comparatively light construction. The material of ¼-in. thickness cannot be reduced, neither can the minimum sizes of angles in the roof trusses. The l/r limitations of 120 and 200 for compression members will often prevent a reduction in the columns and struts. The bracing will usually remain the same whether 16,000 or 18,000 be used. The same may be said of the roof purlins and side girts, door and window framing, if sheet metal be used for a covering.

Plates vary in thickness by the sixteenths of an inch and those $\frac{5}{16}$, $\frac{7}{16}$ and $\frac{9}{16}$ in. thick will be reduced more than 12 per cent by lessening the thickness $\frac{1}{16}$ in. Those ¼ in. thick cannot be reduced at all. It is true that when plates are used in combination with other shapes, as in the flanges of a plate girder, a reduction may at times be made in the combined section. Again, the lightest beams and channels of any section are generally used for the support of floors and roofs. In both the Carnegie and Bethlehem handbooks the section moduli of the next lighter 10-in. shapes are more than 12 per cent less than the lightest 12-in. shapes, the next lighter 9-in. more than 12 per cent less than the lightest 10-in., and so all the way down the list. That is, the ratio of decrease in weight is greater than the ratio of 16,000 to 18,000. This is also true of the Jones & Laughlin "Junior" I-beams, the properties of which were given in *Engineering News-Record* of May 6, 1926, p. 736. It is only when a light-weight beam or channel has an excess of strength that one of lighter section can be used by substituting a unit stress of 18,000 lb. for 16,000 lb. It is true that in many designs there is this slight excess and a reduction may be made. To make comparisons valid, the same engineer should make both designs. The personal equation is then the same. Beams can sometimes be respaced but not often.

In many-storied buildings, a larger reduction can be made. This is especially true of warehouses and floors heavily loaded. Where 24-in. 100-lb. beams are required on a basis of 16,000 lb., it will probably be found that 81.4-lb. beams will answer for 18,000 lb. In the same way, 20-in. I's of 65.4 lb. may be used for 20-in. I's of 81.4 lb.; 15-in. of 42.9 lb. for 15-in. of 50 lb.; 12-in. of 35.0 lb. for 12-in. of 40.8 lb. The saving thus effected will be 20 per cent in the first two cases and 14 per cent in the latter two. But buildings with large numbers of beams of the heavier weights are the exception, not the rule. In office buildings reduction will be chiefly in columns; the upper section or sections can seldom be lessened—the l/r limitation of 120 and the light loads prevent.

No general rule can be given for the amount that can be saved by the proposed substitution, but it is safe to say that for a one-story mill building the saving will *seldom* be more than 6 per cent and for a many-storied hotel, apartment house or office building the saving will *seldom* be as much as 12 per cent.

R. FLEMING.

New York City, May 10, 1926.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Medal Awarded to City Engineer

The medal of the Chamber of Commerce of Cleveland, Ohio, was awarded to Robert Hoffmann, city engineer, on April 13. Other recipients of the medal were O. P. Van Sweringen, M. J. Van Sweringen, and, posthumously, J. H. Wade.

The citation which accompanied Mr. Hoffmann's award was as follows:

"The Cleveland Medal for Public Service is awarded to Robert Hoffmann, City Engineer, who for thirty-three years has served Cleveland in the Department of Engineering, and for nineteen years as Chief Engineer. Undisturbed and uninfluenced by partisan considerations or changes of administration, he has steadily pursued a high policy of intelligent, loyal and effective public service and has both won the confidence of the people and contributed to the physical reconstruction of Cleveland to make the city more adequate for and more responsive to its increasing responsibilities and opportunities."

Money for Hudson River Bridge Not Available Until 1927

The bill making available the sum of $1,000,000 each year for five years for the construction of a bridge over the Hudson River at New York, recently passed by the New York Legislature, provides that the first appropriation shall not become available until July, 1927. This bill, noted in our issue of April 29, p. 706, has been signed by Governor Smith.

Long Island R.R. Improvements

Improvement plans of the Long Island R.R. Co. for the year 1926 call for an expenditure of $11,000,000. The work will include extension of the electrified zone from Floral Park to Mineola and from Mineola to Valley Stream, a total distance of about 12 miles, double tracking on two divisions, grade crossing elimination and bridge rebuilding. Seven electric freight locomotives are being built at a cost of about $900,000.

"Multiple-Dome" Type Dam for Coolidge Reservoir

Report by Board of Engineers Endorsed by Secretary of Interior—Construction to Start Soon

Approving the "multiple-dome" design prepared by the Bureau of Indian Affairs for the Coolidge Dam across the Gila River near San Carlos, Ariz., a special engineering board composed of Gen. Wm. C. Langfitt, and A. J. Wiley has reported to the Secretary of the Interior. The secretary has just announced his endorsement of the report. It is expected that advertisement for bids and award of a contract will follow without delay.

Plans for the dam were prepared by Major C. R. Olberg, assistant chief engineer of the Bureau of Indian Affairs. The structure is to be 250 ft. high and according to the plan now approved would be formed in plan of three arch spans of about 180 ft. each, the axis of each barrel being inclined as in the short-span multiple-arch dams, and in addition being slightly curved in the vertical plane so as to make each span a dome-like structure rather than a barrel arch.

The cost of the structure is estimated at $2,836,000. Some minor modifications in the design are proposed by the board, but except for these the definite adoption of Major Olberg's design is recommended.

The board also recommends constructing a power house and its equipment as part of the construction. It says that a considerable amount of power can be produced in the normal operation of the reservoir for irrigation, that a good market is at hand, that the cost will not be great, and that the power profits will relieve materially the water users' operation and maintenance charges.

BRIDGE FOR EXTENSION OF SPANISH TRAIL APPROACHES COMPLETION

THE first link in the planned extension of the Old Spanish Trail as a continuous tide-water boulevard along the Mississippi Gulf Coast from New Orleans to Mobile will be completed Sept. 1, when D'Iberville Bridge, across the Bay of Biloxi at Biloxi, Miss., is finished at a cost of $350,000. The new bridge, dedicated on March 9, consists of 81 reinforced concrete spans 40 ft. long, and a 207-ft. electrically driven draw-span. Inclusive of the approaches it will have a total length of 3,447 ft., making it the longest highway bridge in Mississippi, one of the longest in the south.

Along the Mississippi coast the drive will for the most part be double and will flank the 20-mile seawall, now under construction as a protective measure for the project.

The bridge will have a clearance of 14 ft. above water and an elevation of 18 ft. A 20-ft. roadway, with a 4-ft. sidewalk along the side, will be guarded on both sides of the bridge with concrete handrails, the entire structure having an overall width of 27 ft.

The Biloxi structure is being built by A. M. Blodgett, Inc., contracting engineers, who built the Galveston Causeway, and was designed by the firm of Hedrick & Frost, designing engineers, of New Orleans.

Fall Meeting of A.S.M.I. to Be at Washington, D. C.

Fewer subjects, more intensive treatment of those handled and posted discussions were the points followed in laying out the program of the next fall convention of the American Society of Municipal Improvements. The meeting is in Washington, D. C., Nov. 8 to 12 but T. Chalkley Hatton, president, called the members together in Chicago April 27 from St. Louis, Milwaukee and LaGrange, Ill. A joint session will be held with the Asphalt Association which meets the same week. Special attention is to be given to street design as affecting traffic control, salvaging old pavements, charges for sewage treatment service, concrete disintegration in conduits, and municipal financing. The committee consists of C. W. S. Sammelman, George W. Tillson, W. W. DeBerard and T. Chalkley Hatton.

Deadlock Delays Expansion of Denver Water Supply

The municipal water supply problems of Denver, Col., involving provision for additional water supply as well as expansion of the distribution system to keep pace with a rapid growth which has added 16,000 taps or 33 per cent since the City acquired the property in 1918 is much in the public eye at the present time pending the appointment of a new Board of Water Commissioners by Mayor Stapleton. Since the resignation of three of the five members became effective April 1 following differences on policies of expansion and abuse from private interests interested in securing control of Western Slope water no new candidates have been found and the $20,000,000 plant is functioning without a legal head, helpless to consummate plans for the use of Fraser River water through the Moffat Tunnel or the development of storage on the South Platte River until new members are appointed.

In the meantime the present water supply is menaced by litigation instituted by ditch owners along the Platte River whose water right priorities clash with those of the city.

As a part of the construction program on the distribution system the 64 m.g.d. rapid filters using anthracite coal as a filtering medium have been put into effective operation so that of the 40 cases of typhoid reported in 1925 not one could be traced to Denver water. The balance of the $6,500,000 bond issue of 1923 has been expended for the construction of concrete and wood stave conduits unto the city, the extension and rehabilitation of the street mains to handle the 22,000,000,000 gal. used per year and additions to the pumping equipment at the Capitol Hill and Ashland Avenue Plants.

Plasterers Demands in Chicago Draw Fire of Western Society

On the eve of a strike in the building industry in Chicago due to demands of the plasterers for an increase in wages of $2 per day making the total $14, the board of direction of the Western Society of Engineers has issued a pronouncement urging its members "to give active support to the continuance of existing conditions." The resolution states that the construction industry will be "menaced by higher rates, shorter hours, restricted purchase of materials, sympathetic or jurisdictional strikes."

Zoning Powers Granted to Towns in New York State

A legislative bill adding to the town law of New York State a new article (17-c) enabling towns to regulate by districts the height, bulk and use of buildings and density of population has been signed by the Governor. A companion bill, also signed by the Governor, relates to the similar zoning powers in portions of towns outside villages.

St. Lawrence Power Plan Before Commission

Two-Stage Development Plan Presented to New York State Commission—Speedy Action Favored

The relative merits of a two-stage against a one-stage development of power in the international section of the St. Lawrence River were discussed before the New York State Water Power Commission on May 6 when the commission heard the application of the American Super-Power Corporation for a preliminary permit for the construction of two power plants on the river, one at the lower end of Ogden Island and the other at the lower end of Barnhart Island near the town of Massena, N. Y. The plan calls for the development of 1,950,000 hp. at a cost of $154,000,000. The estimated time to complete the work of making the initial installation is 36 months as against 54 months estimated for the single-stage development, proposed by the Frontier Corporation. The plans of the latter company, noted in our issue of April 15, p. 627, call for the development of 2,400,000 hp. at an estimated cost of $238,000,000.

Commission Wants Action

The attorney general of the state declared that the commission would not give consideration to priority of application, but would give special attention to the plan which, in the opinion of the commission, would insure a speedy development at a most economical cost and in a feasible manner.

Counsel for the American Super-Power Corporation stated that the financial backers of the corporation included Henry L. Dougherty, R. W. Gardner, A. B. Leach, and Edward C. Randall.

Walter S. Connelly, president of the New York & Ontario Power Co., appeared before the commission to ask that power rights of the company in the St. Lawrence River be protected.

Surety Company Adopts Standard Statements and Questionnaire

Announcement has been made that the National Surety Co. will use, without change or amendment, in the conduct of its contract bond business the standard questionnaires and financial statement for bidders approved and recommended by the Joint Conference on Construction Practices. This use will continue pending the report of a committee of the various surety companies which has in hand the standardization of such forms. The company is adopting the present standard form, it states, because of its desire to co-operate with the Associated General Contractors and the other societies represented in the Joint Conference on Contract Surety Bonds in their movement to promote the betterment of conditions in the construction industry and because of its belief that the uniform use of these forms by all elements having relations with the construction industry will go far to better conditions.

Los Angeles Voters Approve Union Depot at Plaza Site

At a special election in Los Angeles on April 30, proposition 8 on the ballot, calling for an expression of opinion in the form of a "straw vote" on the proposal to build a union railway passenger terminal for all steam railroads entering the city, was approved. The vote was 115,493 for, and 72,714 against. Proposition 9 which similarly asked for an expression on locating such a union terminal at the proposed Plaza site also carried, though by a smaller majority. The vote on No. 9 was 94,546 favoring, and 90,464 opposing. The election brought to the polls 190,000 voters or 60 per cent of total number registered, considered a large percentage for a special election with no offices to be filled and only ten legislative proposition on the ballot.

Other issues of engineering interest were a straw vote on the question of a 28-story city hall and a proposed bridge bond issue of $1,900,000 for viaducts, principally across Los Angeles River at Sixth St. and at Washington St. Both of these proposals carried by majorities of about 2½ to 1.

The approval of the union terminal plan defeats the railroad's alternative proposal to build a system of elevated tracks over city streets and puts on record an expression of public opinion which will be considered in a further hearing on this matter before the California Railroad Commission, May 17. It is understood that if the State Railroad Commission renews the Plaza union depot order issued in 1921 (noted in *Engineering News-Record*, Dec. 22, 1921, p. 1039) that the Interstate Commerce Commission will approve the plan.

New York Engineers and Land Surveyors Organize

The New York Society of Professional Engineers and Land Surveyors was organized in New York City on April 28 "to promote the social and economic welfare of the professional engineers and land surveyors of the State of New York." One of the objects of the society is to aid in the enforcement of the license law in New York State. The New York office of the society is expected to be a state headquarters with local chapters in the various counties throughout the state.

Major Putnam to Make Harbor Survey at Chicago

Rufus W. Putnam, major, Corps of Engineers, U. S. Army, stationed at Chicago, as district engineer of the War Department for the last 5 years has resigned to take charge of surveys for a comprehensive harbor plan for Chicago. Recently the Commercial Club offered to finance such a survey to be made in co-operation with a committee appointed by the mayor. The city council had pleaded lack of funds to prepare the plans which the War Department had requested before issuing permits for bridges over the Chicago River.

WASHINGTON NOTES

ANOTHER effort to secure legislation intended to increase the use in this country of metric weights and measures has failed. After public hearings, at which the proponents and the opponents presented extended arguments, a majority of the Committee on Coinage, Weights, and Measures of the House of Representatives was unwilling to recommend the bill providing for a restricted use of metric measures after nine years.

A bill proposing that the Bureau of Standards investigate and report on the matter was voted down.

This latter bill then was introduced in the Senate by Mr. McKinley, of Illinois, but he has stated that he does not expect to push it at this session.

MORE than the question of lake levels and the loss of waterpower potentialities are involved in the diversion of water from the Great Lakes at Chicago. A hundred members of the House of Representatives have banded themselves together in an agreement to do all in their power to prevent the passage of the River and Harbor Bill, if the Illinois River item is left in the proposed legislation.

The nucleus of this organized opposition comes from the Lake states. These members of the House contend that the item would give legal recognition to the diversion. As this is written it looks as though the bill can be put through the House despite the determined character of the opposition, but in the Senate the Lake states have sixteen members. They are in a position to prevent the passage of the bill at this session, at least.

On the other hand, the proponents of the Illinois River project contend that the real objective of the opposition is to check the migration of industry to Chicago and the Mississippi Valley. They contend that the 10,000 sec.-ft. they want from the lakes can be offset by controlling works or by providing for more water from Canadian sources. It is argued that with water-borne coal and an outlet to tidewater with the completion of the Lakes-to-Gulf waterway, that the Chicago area would attract steel plants and other enterprises at the expense of Lake cities. But to make the waterway across Illinois really successful the full 10,000 sec.ft. are needed, say the Mississippi Valley legislators.

AN INVESTIGATION of the extent to which spillways can be used on the lower Mississippi river to reduce flood heights is to be made by a board of engineers consisting of the following members of the Corps of Engineers: Col. John C. Oakes, Charleston; Lieut. Col. George B. Pillsbury, Detroit; Major Julian L. Schley, Galveston; Major Howard S. Bennion, New Orleans; and Major John C. Gotwals, St. Louis.

For a number of years there has been a demand in New Orleans for an actual trial of some form of outlet. The Mississippi River Commission has been unwilling to finance the experiment, although it interposed no objection to the issuance of a permit for a spillway into Lake Borgne if it were financed by the local interests. This plan was blocked, however, when the Mississippi Senators filed objections to the issuance of any permit which would allow the diversion of water from the Mississippi river into Mississippi Sound.

The bill which was approved recently provides only for the study of possible sites on the West bank of the river or on the East side near the mouth of the river where any deposits of silt would not affect the channels as bathing beaches along the Mississippi coast.

The Safe River Committee of New Orleans sent a delegation to Washington recently to urge that some nationally-known hydraulic engineer be chosen from civil life as one of the members of the engineering board. This was regarded as impractical, since the legislation makes no provision for compensating a civilian member of the board. In the past all surveys of this character ordered by Congress have been carried out by government engineers, unless the act specified otherwise.

It was the intent of those responsible for the legislation that this survey be made by the Corps of Engineers rather than by the Mississippi River Commission. Major Bennion for the past year has been in charge of the New Orleans district for the commission, but the local interests stated that they were convinced that he would consider the matter with an open mind.

Seaboard Railroad Extension in Florida Held Up

Extension of the Seaboard Air Line R.R. into Miami, Fla., has been held up by the inability of the railroad company to obtain some necessary portions of right-of-way. When the railroad proposed to extend its line to Miami it encountered so much speculation in the land which it needed for its right-of-way that it considered abandoning the extension. As a result a committee of citizens was made up to obtain the necessary real estate for the railroad company. It is stated now that this committee has been unable to obtain the land which it had expected to get for the railroad's right-of-way.

Engineering Fifty Years Ago

From *Engineering News*, May, 1876

Narrow-Gage Railways

ONE of the most serious questions in the future of our railway system is that presented by the introduction of the narrow-gage lines, which of late have been multiplying in different parts of the country. So long as the success of such roads seemed problematical they excited but little attention, but now that a number of lines have been in operation long enough to prove them to be profitable experiments, the inquiry as to their influence upon the older and more expensive lines becomes interesting, and may, perhaps, be useful to all friends of internal improvement. In looking over the railway items of the day, we find in the state of Ohio some 800 miles of these narrow-gage roads in process of construction or projected, while in Massachusetts, Pennsylvania, and several other states, some lines are in successful operation, while others are starting into life. As a rough estimate, we should say that at least 1,500 miles of these narrow-gage roads were in various stages of progress, and most of these have been projected within the last six months. The significance of this statement of railway enterprise during a period of profound business depression, and when people have been great losers by investments in new railways of the regular 4 feet 8½ inch gage, will be readily understood. It is something like a popular verdict in favor of the narrow-gage system, all the more pronounced because it comes at a time when the construction of railways of the ordinary gage had almost entirely ceased, except in the completion of lines partially built.

It is claimed that these roads of three feet gage can be built at two-thirds of the cost of the 4 feet 8½ inch tracks, and that they can be operated at about the same proportion of expense, and this claim seems to have been established satisfactorily wherever they have been constructed. The Denver & Rio Grande road, which is to extend from Denver, Colorado, to El Paso, in Texas, a distance of 850 miles, has been in successful operation for some time, although not yet completed. The Parker & Kansas City road, in Pennsylvania, has done a large and profitable business for several years, and in Massachusetts the Revere Beach & Lynn road, from Boston to Lynn, opened in August, 1875, actually earned 8 per cent on its capital during the first six months of its operation, without carrying a pound of freight, and this, too, in competition with the Eastern, one of the oldest lines in the state. These facts give unusual prominence to the narrow-gage question, and cause thoughtful men to look with some anxiety as to the bearing of a development which promises to increase.

Civil Service Examinations

UNITED STATES

For the following civil service examinations, apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Commission.

Engineering Aid, and Senior Engineering Aid—Vacancy in the Bureau of Public Roads, as engineering aid, for duty at Arlington, Va., salary $1,680; and vacancy in the Office of Civil Engineer, Coast Guard, Washington, D. C., salary $1,860; with salary advances to $2,040 and $2,400 respectively and the usual promotion; elementary engineering education required.

Period of application for these examinations will close June 12.

Chief Engineering Inspector-Superintendent, and Senior Engineering Inspector-Foreman — Vacancies in the United States Bureau of Public Roads for duty in western states, open only to persons domiciled in western states, salaries $3,000 and $2,400 respectively, with the usual promotions. Information may be secured from the U. S. Civil Service office in western cities, from Albuquerque, N. M., San Francisco, Calif., etc., to Juneau, Alaska.

Period of application for these examinations will close June 22.

Engineering Societies

Calendar

Annual Meetings

CONFERENCE OF STATE SANITARY ENGINEERS, Washington, D. C.; Annual Meeting, Buffalo, N. Y., June 5 and 7, 1926.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Meeting, Buffalo, N. Y., June 7-11, 1926.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago, Ill.; Annual Convention, Philadelphia, Pa., June 13-19, 1926.

SOCIETY FOR PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Meeting, State University of Iowa, Iowa City, June 16-18, 1926.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; Annual Meeting, Atlantic City, N. J.; June 21-25, 1926.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York, N. Y.; Summer Meeting, Seattle, Wash., July 14-16; Annual Convention, Philadelphia, Pa., October 4-9, 1926.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Meeting, Providence, R. I., Sept. 14-17, 1926.

INTERNATIONAL CITY MANAGERS' ASSOCIATION, Lawrence, Kansas; Annual Convention, Colorado Springs, Colo., Sept. 21-23, 1926.

The Florida Engineering Society at its meeting April 19 in Jacksonville elected the following officers: President, H. D. Mendenhall, consulting engineer, Lakeland; vice-presidents, G. W. Simons, Jr., chief engineer, Consolidated Development & Engineering Corporation, Jacksonville, and C. A. Brown, Orlando; secretary, P. L. Reed, professor of civil engineering, University of Florida, Gainsville; and treasurer, G. A. Mason, Daytona.

The National Lime Association will hold its eighth annual convention at French Lick, Ind., June 8-11. The tentative program calls for executive meetings on Tuesday and technical sessions on Wednesday and Thursday.

Personal Notes

W. R. HOLWAY, recently chief engineer of the Spavinaw Water Project for Tulsa, Okla., has been retained by the Cuban Government to assist in preparing plans and specifications for a water-supply project for Santiago, costing $6,000,000. Mr. Holway has been in Cuba for the past three months, and made a report to the government on this project.

BAXTER L. BROWN, consulting engineer, St. Louis, Mo., has been elected permanent chairman of the Independence Celebration and Exposition to be held by the St. Louis Chamber of Commerce, Sept. 4 to 19.

FRANK L. WEAVER, associated with Hubbell, Hartgering and Roth, consulting engineers, Detroit, Mich., has been appointed city engineer of Wyandotte, Mich.

J. J. P. MACKENZIE, formerly with the Brooklyn Edison Co.'s engineering investigation bureau of the mechanical engineers' department, has joined the Engineering Products Division of the Walworth Co., Boston, Mass., as assistant engineer; this division recently established headquarters in the Vanderbilt Building, New York City.

W. F. WELSCH, division engineer, has been assigned in charge of the Western division, and EDWARD ANDERBERG, in charge of the Eastern division, of the Westchester County Park Commission, effective May 1, with temporary offices at the headquarters office in Bronxville, N. Y.

ARTHUR E. HATCH, Providence, R. I., until recently engineer and assistant manager of the J. S. Packard Dredging Co., has become associated with Charles E. Fitz & Co., Boston, Mass., an industrial real estate company.

MAJOR MALCOLM ELLIOTT, Corps of Engineers, has been ordered to New Orleans as district engineer following completion of the course at the General Service School, Fort Leavenworth, Kansas.

NELSON N. FULLER, assistant health officer of Montclair, N. J., and previously engaged in public health sanitation engineering in Rhode Island, has been appointed sanitation engineer of the city of Jacksonville, Florida.

JOHN D. STEVENSON, Pittsburgh, Pa., has been appointed chief engineer of the newly established bureau of bridges and structures in the department of public works of the city of Pittsburgh. Since last year Mr. Stevenson has been designing engineer of the bureau of roads of the Allegheny County department of public works, but he had previously served in the division of bridges in the city of Pittsburgh. F. C. CODER has been appointed division engineer of construction and C. A. CHANEY engineer of the new design division of the Pittsburgh city department of public works; Mr. Coder formerly was employed by Allegheny County as division engineer in highway work, and Mr. Chaney was engineer of the former city division of bridges.

G. M. RAPP has resigned as assistant engineer with the Delaware River Bridge Joint Commission to accept a position as assistant engineer with the Port of New York Authority where he will be engaged in work on the proposed Hudson River bridge.

G. F. DAGGETT, assistant engineer with the Wisconsin Highway Commission, Madison, has resigned to become executive secretary of the Wisconsin Mineral Aggregate Association, Milwaukee; Mr. Daggett had been with the highway commission for thirteen years.

Obituary

WILLIAM THEISNER, of Buenos Aires, Argentina, who was city engineer of Salina, Kansas, for four years starting with its establishment of the city-manager-commission form of government and closing with his resignation in August, 1925, to go to South America, was killed recently in Argentina. Mr. Theisner served in the Engineer Corps in France during the War.

DR. CARL HERING, noted physicist and consulting electrical engineer, Philadelphia, Pa., died May 10 at his home in that city, at the age of 66 years. Dr. Hering was the discoverer of a number of new laws in physics and chemistry and the inventor of some electrochemical and other processes. He was editor of *Electrical World* in 1891 and for many years a writer of books and articles. Dr. Hering was born in Philadelphia, graduated from the University of Philadelphia and in his early years was instructor there in physics. He also studied for a time in Germany and practiced in Frankfort. The French government appointed him an officer of Public Instruction and made him a Knight of the Legion of Honor.

Prof. GEORGE B. WHAREN, head of the Mechanical Engineering Department of the University of North Dakota, died at Grand Forks, N. D., May 1, 1926. He was born at Wilkes-Barre, Pa., Oct. 14, 1883. Mr. Wharen graduated from Pennsylvania State College in 1910. He was for a time connected with the drafting department of the American Locomotive Co., at Schenectady, N. Y., and the motive power department of the Pennsylvania R.R. at Altoona, Pa. Subsequently he was instructor in mechanical drawing at Wentworth Institute, Boston, and in mechanical engineering at the University of Pennsylvania. In 1920 he became head of the Department of Mechanical Engineering of the University of North Dakota and held that position until his death.

Roster of Veteran Subscribers

Engineers and contractors who have been readers of *Engineering News-Record* for 25 years or more

SUBSCRIBERS who have long been faithful continuous readers of "Engineering News-Record" and its predecessors, some of the readers having begun with the first issue of Volume I back in 1874, are named here. These are additional to the long-time subscribers named in our issue of February 4, 1926, p. 213. All those named below have been subscribers 25 years or more.

Albert B. Drake,
Civil Engineer, New Bedford, Mass 52

Edwin A. Fisher,
Cons. Eng. to City of Rochester, Rochester, N. Y..... 50

Desmond FitzGerald,
Consulting Engineer, Brookline, Mass. 50

T. K. Mathewson and father,
J. A. Mathewson, 282 Calle de Siglo XX, Santiago, Chile, S. A. 52

J. D. Du Shane,
U. S. Civil Engineer (Retired), Yakima, Wash..... 50

Kenneth Allen,
Board of Estimate and Apportionment, New York, N.Y. 45

Horace Andrews,
Civil Engineer, Albany, N.Y. 48

William H. Breithaupt,
Civil Engineer, Kitchener, Ontario 40

A. T. Byrne,
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O. W. Childs,
Bridge Engineer, Denver Steel & Iron Works..... 41

Edward B. Codwise,
Retired Engineer, Kingston, N. Y..... 42

L. W. Goddard,
U. S. Engineer Office, Grand Rapids, Mich. 40

L. J. H. Grossart,
Civil Engineer, Allentown, Pa. 41

H. Hawgood,
Consulting Engineer, Los Angeles, Calif..... 40

W. C. Hawley,
Chief Eng. and Supt. Pennsylvania Water Co., Wilkinsburg, Pa. 40

Sidney F. Heckert,
Archt., Bessemer Building, Pittsburgh, Pa. 41

Malverd A. Howe,
Emeritus Prof. of C. E., Rose Polytechnic Institute, Terre Haute, Ind. 48

C. F. Loweth,
Chief Engineer, C., M. & St. P. R.R., Chicago, Ill.. 46

H. DeB. Parsons,
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University of Illinois, Urbana, Ill. 45

J. W. Votey,
Dean, College of Eng., Univ. of Vermont, Burlington, Vt. 45

Samuel T. Wagner,
Chief Engineer, Reading Co., Philadelphia, Pa..... 45

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Treasurer, Mohawk Dredge & Dock Co., Herkimer, N.Y. 30

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Sec. and Treas., Rogers & Baldwin Hardware Co., Springfield, Mo. 35

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Cons. Eng., First Nat. Bank Bldg., Denver, Colo. 38

H. W. Clark,
Chief Chemist, State Exp. Sta., Lawrence, Mass..... 30

C. R. Coutlee,
835 Hunter Building, Ottawa, Ont., Canada..... 37

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Chief Eng. and Gen. Mgr., East Bay Municipal Utility District, Oakland, Calif... 34

Lynn L. Davis,
Prin. Asst. Engr., U. S. Eng. Office, Buffalo, N. Y. 30

Ralph B. Dildine,
Dildine Bridge & Iron Co., Hannibal, Mo. 30

A. E. Duckham,
Consulting Engineer, Pittsburgh, Pa. 32

Frank H. Eno,
Professor of Mun. Eng., Ohio State Univ., Columbus 37

Samuel D. Fisher,
Cons. Eng., M.-K.-T. R.R., Parsons, Kansas 39

W. L. Glazier,
Glazier & Morlidge, Civ. Engrs., Cincinnati, Ohio 35

Philip E. Harroun,
Consulting Engineer, San Francisco, Calif. 38

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Consulting Engineer, New York, N. Y..... 37

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Engrs., 111 Broadway, New York, N. Y..... 36

George H. Leland,
Consulting Engineer, Providence, R. I..... 39

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U. S. Asst. Engr., U. S. Lake Survey, Detroit, Mich. 31

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V.-P., Hurley Mason Co., Portland, Ore. 34

William E. Mott,
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Leslie Muller,
Farmer, Box 516, Shelton, Wash..... 30

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Surveyor, St. Clair County Highway Dept., East St. Louis, Ill. 37

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Cornell University, Ithaca, N. Y..... 33

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Consulting Engineer, Columbus, Ohio 31

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506 E. Fourth St., Alton, Ill. 35

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30 Park St., Webster, Mass. 31

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Pres., Clinton Bridge Works, Clinton, Iowa 34

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Walbridge-Aldinger Co., Detroit, Mich. 26

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N. J. Beisel,
Supt. Pottsville Water Co., Pottsville, Pa. 28

D. M. Belcher,
Gen. Mgr., Coffin Valve Co., Boston, Mass. 26

Howard S. Bennett,
Cons. Engr., Baltimore, Md. 28

Charles H. Bigelow,
Plant Engr., Spicer Mfg. Co., Plainfield, N. J..... 25

W. L. Brayton,
Bridge Engr., Union Pacific R.R. Co., Omaha, Neb.... 25

Thos. H. Carver,
Asst. Engr., City of Seattle, Seattle, Wash. 29

Robert A. Chaffee,
Civ. Engr. New York, N. Y. 25

W. A. Clapp,
Civ. Engr., U. S. Army, Chicago, Ill. 27

S. F. Creecellus,
City Engr., San Antonio, Texas 25

W. W. Crosby,
Location Engineer, Dept. of Highways, Harrisburg, Pa.. 25

E. M. Culp,
Culp Co., Inc., Gen. Contr., Paterson, N. J..... 26

James L. Davis,
Res. Engr., Henry B. Smith, Melbourne, Fla. 26

H. W. De Graff,
Amer. Pipe & Const. Co., Amsterdam, N. Y..... 29

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Prin. Asst. Engr., Duluth & Iron Range R.R..... 27

John Dyer, Jr.,
Contr., Albany, N. Y..... 27

James V. Ferry,
Contr., Atlantic City, N. J. 26

H. De B. Forbes,
Civ. Engr., Richmond, Ky. 26

Charles Kirby Fox,
Consulting Engineer, Los Angeles, Calif. 25

Edward Gagel,
Ch. Engr., N. Y., N. H. & Hart. R.R., New Haven, Conn. 25

Frank J. Gallagher,
Gen. Contr., Brooklyn, N. Y. 28

John H. Gregory,
Cons. Engr., Johns Hopkins Univ., Baltimore, Md. 28

George J. Griesenauer,
Cement Tester, Chicago, Ill. 25

Dan Gutleben,
Chf. Engr., Penns. Sugar Co., Philadelphia, Pa..... 26

H. A. Hanson,
301 W. 42nd St., New York, N. Y..... 27

H. M. Harps,
McCoy Iron Works, Utica, N. Y. 25

Frank S. Hart,
Civ. Engr., Framingham, Mass. 28

G. P. Hawley,
Cedar Rapids Mfg. & Pwr. Co., Montreal, Que., Can.. 28

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William Hood,
Ch. Engr. (retired) Southern Pacific Co., San Francisco.. 25

R. W. How,
Cons. Engr., Orlando, Fla.. 27

H. J. Hughes,
Dean Engng., Harvard Univ., Cambridge, Mass. 25

Hiram F. Jones,
Supt., Filtration Plant, Water Bd., Elmira, N. Y.. 25

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Contr., Atlantic City, N. J. 26

F. Lavis,
Engr., N. J. State Hwy. Dept., Jersey City, N. J.. 28

Robert W. Lesley,
Cons. Editor of *Concrete*, Philadelphia, Pa. 25

A. C. Loomis,
Gen. Contr., Mattoon, Ill.. 28

W. H. Magwood,
Civ. Engr. & Contr., Cornwall, Ont. 25

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Appraisal Engineer, Pasadena, Calif. 26

William P. Mason,
Prof. Chem., Rensselaer Poly. Inst., Troy, N. Y... 25

Thaddeus Merriman,
Ch. Engr., Bd. Water Supply, New York, N. Y..... 28

R. S. Moore,
Res. Engr., J. A. L. Waddell, New York 28

J. C. Morris,
Civ. Engr., New Orleans, La. 25

R. A. McCulloch,
Supt. Marc Eidlitz & Son, Inc., New York, N. Y.... 26

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Mgr., Nicholson Engineering Co., Tacoma, Wash. 27

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Civ. Eng., N. Y. Central R.R., Ossining, N. Y..... 27

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Pres., F. S. Odell Engng. Corp., Port Chester, N. Y. 25

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Wray, Parsons & Co., Waukegan, Ill. 26

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Sanitary Engr., Sanitary Dist., of Chicago, Chicago, Ill. 25

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Civil Engineer, Seattle, Wash. 26

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Const. Engr., Mulholland Highway, Los Angeles, Calif. 28

A. J. Roell,
Structural Engineer, Montclair, N. J. 25

F. B. Scheetz,
Bridge Engr., Govt. Service, Washington, D. C..... 28

W. M. Scott,
Chairman, Board of Commissioners, Greater Winnipeg Water Dist., Winnipeg, Manitoba 25

Scott Brothers,
Contractors, Rome, N. Y.. 28

W. K. Scotten,
Mgr., Northern Div., Montana Power Co., Great Falls, Mont. 25

F. J. Seery,
Prof. Civ. Engng., Cornell University, Ithaca, N. Y... 28

W. M. P. Shelton,
Civil & Cons. Engr., Burlington, Iowa 29

J. W. Silliman,
Civ. Engr., Bur. Highways, Philadelphia, Pa.. 28

B. G. Slining,
Consulting Engineer, University City, Mo..... 25

Leonard C. L. Smith,
Civ. Engr., Long Island City, N. Y. 25

Walter M. Smith,
Ch. Desg. Engr., Dept. Pub. Wks., Chicago, Ill. 27

William H. Spangler,
Val. Engr., Lehigh & N. E. R.R., Allentown, Pa..... 27

Wm. A. Taylor,
City Engr., Dickson, Pa., Olyphant, Pa. 28

Chester G. Taylor,
Asst. Engr., Duluth, Messabe & Northern Ry., Duluth, Minn. 27

Alfred F. Theard,
Civ. Engr., New Orleans, La. 29

R. K. Tiffany,
Cons. Irrigation Engr., Spokane, Wash. 26

C. J. Tilden,
Prof. of Engrg. Mechanics, Yale Univ., New Haven, Conn. 25

Maurice P. Van Buren,
Engr. Fougner Concrete Steel Co., New York, N. Y. 25

H. E. Wegner,
Contracting Engineer, Harrisburg, Pa. 26

E. T. Wilkie,
Civ. Engr., Can. Natl. Rys., Toronto, Ont., Can..... 28

A. J. Wise,
Civ. Engr., Houston, Texas 27

B. A. Wise,
City Engineer, Bradford, Pa. 26

N. M. Works,
Asst. Supt., U. S. Lighthouse Dept., Milwaukee, Wis. 28

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Manufacturers Apply for Space at Water Works Convention

The following applications for space have been received for the convention of the American Water Works Association to be held in Buffalo, N. Y., June 7-11. It is probable that further applications will be made.

Wallace & Tiernan Co., Inc.
B. Nicoll Co.
Mueller Co.
A. P. Smith Mfg. Co.
Union Water Meter Co.
Cement Lined Pipe Co.
East Jersey Pipe Co.
F. B. Leopold Co.
Pittsburgh Testing Laboratory
Pittsburgh Meter Co.
Worthington Pump & Machinery Co.
Central Foundry Co.
Canadian Engineer
Pittsburgh-Des Moines Steel Company
National Tube Co.
Kennedy Valve Co.
Hays Mfg. Co.
Sullivan Machinery Co.
Chicago Bridge & Iron Works
Electro Bleaching Gas Co.
R. D. Wood & Company
Hersey Mfg. Co.
International Filter Co.
U. S. Cast Iron Pipe & Foundry Co.
Giant Mfg. Co.
American Cast Iron Pipe Co.
McWane Cast Iron Pipe Co.
Water Works Equipment Co.
Layne & Bowler Co.
Victaulic Company of America
Edward E. Johnson, Inc.
Neptune Meter Company
Water Works Engineering
Bingham & Taylor—W. P. Taylor Co. Successor
Federal Meter Corp.
National Water Main Cleaning Co.
Columbian Iron Works
Talbot Non-Corrosive Linings Co.
Ford Meter Box Co.
Buffalo Meter Co.
Eddy Valve Co.
The Pitometer Co.
Gamon Meter Co.
American Brass Company
Ross Valve Mfg. Co.
Rensselaer Valve Co.
Leadite Company
W. & L. E. Gurley
Engineering News-Record
Engineering & Contracting Publishing Co.
Paradon Engineering Co.
Edson Mfg. Co.
Birch Mfg. Co.
Joseph G. Pollard Co., Inc.
Simplex Valve & Meter Co.
Ludlow Valve Mfg. Co.
National Meter Co.
Lead Lined Iron Pipe Co.
Builders Iron Foundry.

Asphalt Paving Yardage Shows Large Increase

The annual report of J. E. Pennybacker, secretary of the Asphalt Association, gives the yardages of asphalt annually laid in the United States since 1919. These yardages are reproduced in the accompanying table:

ANNUAL YARDAGE CONSTRUCTION OF ASPHALT PAVING IN THE UNITED STATES

1919	55,700,000	sq.yd.
1920	73,800,000	" "
1921	71,200,000	" "
1922	89,900,000	" "
1923	108,000,000	" "
1924	124,800,000	" "
1925	(Estimated) 140,000,000	" "

Zinc Dust for Painting

An elaborate technical discussion of the value and use of metallic zinc powder or zinc dust as a paint pigment has been issued by the New Jersey Zinc Co. as a research bulletin. H. A. Nelson and W. A. McKim are the authors. For many uses this pigment is said to offer decided advantages. It is recommended for use in a mixture with zinc oxide, (about 20 per cent zinc oxide and the remainder zinc dust). The elasticity of the paint films and the great hiding power of the zinc dust are emphasized.

Business Notes

MUNDY SALES CORP., New York City, has just completed negotiations for handling through its sales representatives the Shannon line of hoists manufactured in Philadelphia.

WATSON TRUCK CORP., Canastota, N. Y., announces a change in its corporate name to the Rex-Watson Corp.

GEORGE HAISS MFG. CO., INC., New York, N. Y., announces the appointment of two new Florida distributors for the East Coast and the Burress-Clark Machinery Co. for Tampa.

T. L. SMITH CO., Milwaukee, Wis., announces the appointment of the following distributors: I. E. Schilling Co., Miami, Fla., and the O. B. Avery Co., St. Louis, Mo. The latter's territory includes eastern Missouri and southern Illinois.

LIDGERWOOD MFG. CO., New York City, announces that R. J. Rudd has taken charge of its Cleveland office, which is located in the Atlas Building.

UNIVERSAL POWER SHOVEL CO., Detroit, Mich., is the new name for the Wilford Power Shovel Co., manufacturers of a crawler-mounted Fordson-powered excavating shovel. Officers are William Ford, president, D. H. Millard, vice-president, and Frank Temple, secretary-treasurer.

WHITE CO., Cleveland, has issued its annual roll call listing the number of its trucks in fleets of 10 or more; it lists 961 owners operating 35,755 trucks. This represents the biggest roll call in the company's history. One owner operates 1,929 trucks, three others have 1,000 trucks, and there are 40 owners operating over 100 trucks.

READING CHAIN AND BLOCK CORP., Reading Pa., has recently opened an office in Pittsburgh, in charge of Lloyd W. Lutz.

TRACK SPECIALTIES CO., 29 Broadway, New York, N. Y., announces the appointment of M. K. Northam as its Chicago representative, with offices in the New York Life Building.

PARADON ENGINEERING CO., Long Island City, N. Y., announces the removal of its southwest district office from Tulsa, Okla., to the Local Building, Oklahoma City. Lawrence K. Cecil still retains charge of the sales and service in the southwest and is assisted by E. P. Thomas.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO., East Pittsburgh, Pa., announces that J. McA. Duncan, for 14 years Pittsburgh district manager, has been promoted to assistant general sales manager of the company. W. R. Marshall, formerly branch manager at Buffalo, has been selected to assume the duties of Pittsburgh district manager.

A. W. WARREN, recently doing advertising work for the Baldwin Chain & Mfg. Co., Worcester, Mass., has been appointed sales manager of the company effective April 15.

Equipment and Materials

Machine for Sanding Wet and Icy Hills

In carrying New York City commuters from the Hudson River ferry stations to their homes in New Jersey, the Public Service Transportation Co. operates a large number of buses, and in wintry weather experiences considerable difficulty in climbing the hills leading to the top of the Palisades. The placing of sand or ashes on these hills was necessary for economy and

safety and the equipment illustrated was built for the Public Service Transportation Co. by Chas. Hvass & Co. Inc., New York City and used during the past winter.

The equipment is similar in design to this company's equipment for spreading sand and gravel chips on top of bituminous treated roads. The spreader unit is self contained and is fastened to the truck chassis by clip bolts so that it may be removed to release the truck for other duties in the off season. It uses a separate power plant for its operation. The sand is spread by centrifugal force from the revolving cone to a distance of approximately 15 ft.

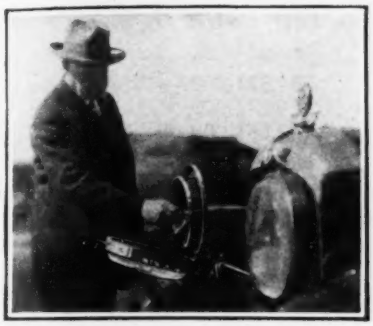
The amount of material fed from the hopper is regulated by an up-and-down adjustment of the cone; raising the cone closes the opening from the hopper, while lowering it permits the sand to run out. The hopper is of 3 cu.yd. capacity made of $\frac{1}{4}$ in. steel plate. The cone is No. 12 gage steel. The end gates shown at the rear of the hopper are used for hand loading, although an

elevating bucket loader is ordinarily used to fill the hopper.

This equipment could also be advantageously used for spreading chips in constructing bituminous pavements. By running the truck backward the wheels would not pick up the freshly placed bitumin as is the case when the spreader is pulled behind a tractor or truck.

New Automobile Headlight

A new type automobile headlight, radically different from any now in use, has been developed by the General Electric Co., Schenectady, N. Y. It is claimed that the lights not only illuminate the roadway for a distance of



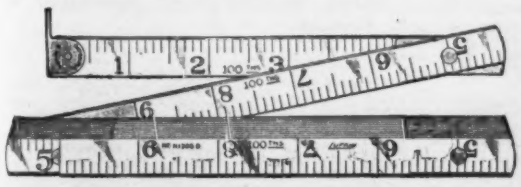
200 ft., but that road signs may be read even when the front end of the car is several feet past such signs. This backward light is one of the unique features of the new headlights. The lights are also claimed to be non-glaring.

The new lights are very thin, being slightly more than 3 in. in thickness, including the projecting lens. The reflector and lens are such that the light from one lamp casts a double crescent of light. The light from the upper portion is the long range beam and the light from the lower portion, inverted by the reflector, is superimposed on the other in such a way as to spread the illumination evenly over the road and light the ditches on either side.

The lamps are not yet being manufactured but W. D'Arcy Ryan, director of the General Electric Illuminating Engineering Laboratory, and inventor of the light, states that he hopes they will be on the market by late summer.

Aluminum Rule Graduated in Decimal System

A folding aluminum rule graduated in tenths and one-hundredths of a foot is now offered by the Lufkin Rule Company, Saginaw, Mich., supplementing its established line of aluminum rules in inch marking. However, the opposite side of this new rule bears the common graduation in one-sixteenths of an inch and since the graduations begin at the same end on both sides, measurements with either scale may readily be converted into terms of the other. The rule is made in a 6-ft. length with 6-in. sections, and can be supplied either with or without the folding end hook. The zero point falls at the inside of the hook when open and at the extreme end of the rule when the hook is closed. Using solid brass joints, the rule is rust-proof throughout.

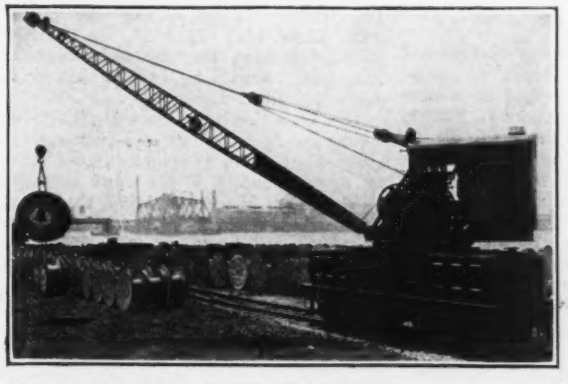


Power Plant Available for Portable Rail Layers

There are in use on practically every railroad a number of portable rail laying machines for relaying track necessary to proper maintenance. To speed up the operation of these machines, which usually require about four men on the cranks, the Woolery Machine Co., Minneapolis, Minn., has designed a power attachment for them. It consists of a 9-hp. single cylinder water-cooled gasoline engine, transmitting its power to the rail layer through a friction drive, with gear and pinion. Any of the standard makes of portable rail layers can be equipped with this power unit. Its weight is approximately 160 lb.

Storage Battery Power on Locomotive Crane

An electric storage battery locomotive crane has been built by the Brown Hoisting Machinery Co., Cleveland, Ohio, for the use of the Western Electric Co. at its Kearny, N. J., works. It is used to handle reels of lead-covered cable as shown in the illustration. As

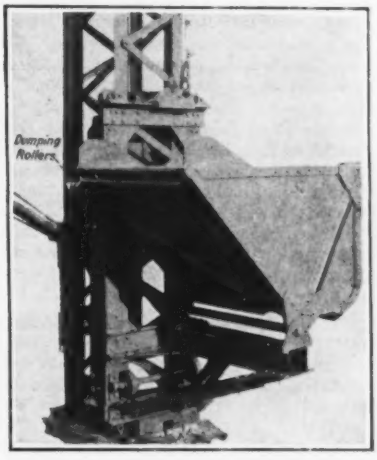


also will be noted, the center of gravity of this machine is rather high and an extra heavy counterweight, 19,400 lb., has to be used in the superstructure. The crane is capable of lifting 10,000 lb. at a 50-ft. radius.

The power is supplied to the electric motors from a 100-cell storage battery of 1,080 amp.hr. and 230 volts. This battery is designed to operate the crane at maximum capacity for one day before recharging. A 100-hp. motor is used for traveling and hoisting while a 25-hp. motor operates the rotating movement. The speeds of the motors are varied by separate drum type controllers and the crane's operations are through friction clutches.

Larger Size Bucket for Mast Hoist Plant

A new tip-over type bucket of 21 cu.ft. capacity has just been developed by the Insley Mfg. Co., Indianapolis, Ind. In connection with it, a mast-hoist plant has also been developed of the same general design as the com-



pany has been manufacturing, but made up of heavier members. It is designed to carry a 40-ft. boom and 40-ft. counterweight chute. The same type of equipment using a 14 cu.ft. bucket has been used during 1925 for jobs having a yardage of 4,000 to 10,000 cu.yd. of concrete.

Each bucket has a set of dumping rollers on the right-hand front cover which engage a switch on the hopper connecting chute, thus automatically dumping the bucket at whatever point the receiving hopper is located. A feature of this arrangement is the fact that the bucket rollers can pass through the dumping switch, and the bucket can travel on up the mast, in the event the engineer fails to stop at an exact point. Upon being lowered, the rollers pass through the switch again, and the bucket rights itself.

This new heavy mast can be set up to a height of 200-ft. in the clear, and higher if tied to buildings. It is made in 20-ft. interchangeable sections. A material elevator is furnished which will operate on the opposite face of the mast from that on which the concrete bucket is hoisted.

Publications from the Construction Industry

Electric Motor Efficiency—GENERAL ELECTRIC CO., Schenectady, N. Y., in a new bulletin entitled "Power Factor and Means for Its Improvement," gives much valuable information on improv-

ing the efficiency of electric power systems in industrial and large contractors' plants. The book is a practical treatise on power factor with mathematics reduced to simple arithmetic.

Trench Excavators — MOORE TRENCH MACHINE CO., Rockaway, N. J., devotes a new 28-page catalog to the use of its overhead conveying system on sewer excavation and construction. Many illustrations are shown of the traveling trestle on various kinds of work and under variable conditions.

Sewer Pipe Jointing—PRESSTITE ENGINEERING CO., St. Louis, Mo., describes the manufacture, application and advantages of its jointing material, Presstite, which is a precast cold pressed asphalt joint, moulded into strips and cut to the exact lengths required to fit various sizes of pipe.

Wood Pipe and Tanks — REDWOOD MANUFACTURERS CO., San Francisco, has recently published two catalogs numbered 11 and 21 on the subject of redwood pipe and redwood tanks respectively. The pipe catalog which is in the nature of a treatise on wood stave pipe gives illustrations and line drawings of many installations besides describing them and giving instructions for installing under various conditions. Tables and useful hydraulic formulas and data complete the book. The other catalog sets forth the principles involved and general instructions for building foundations for and setting up wooden tanks. Tables giving general data on both the tanks and the tower are also included.

Method of Constructing Reinforced Concrete Floors and Roofs on Steel Columns — This is described in a new catalog just issued by LESLIE G. BERRY, structural engineer, Charlotte, N. C. The method entails the use of temporary steel beams or struts running between the steel columns. These beams support the forms for the concrete slabs. The booklet gives sketches of the structural details used with the system. Patent has been applied for on this method of construction.

Cinder Building Blocks — CROZIER-STRAUB INC., New York City, has issued a 208-p. book in the form of a treatise on the use of cinder blocks in different kinds of buildings. A separate chapter is devoted to each type of building, such as houses, garages, hotels, industrial buildings, etc. In addition to this, there are given suggestions for handling and laying the blocks, specifications for construction, and working plans for erection purposes. A chapter is also given on the fire resistivity of cinder building blocks.

Air Compressors—SCHRAMM, INC., West Chester, Pa., was issued the 1926 edition of its catalog, describing its complete line of air compressors. Several illustrations of the equipment on various types of construction work are given.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

This Week's Contracts—Week Ago—Same Week Last Year

THE money value of contracts reported in the present issue of *Engineering News-Record* is here compared with the figures for corresponding weeks. Minimum costs observed are: $15,000 for water-works and excavations; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial buildings.

Money Value of Contracts Let—Entire U. S.

Week Ending	Public Work	Private Work	Total Contracts
May 13, 1926	$18,368,000	$34,371,000	$52,739,000
May 6, 1926	30,450,000	29,841,000	60,291,000
May 14, 1925	22,045,000	42,667,000	64,712,000
Heaviest Week			
1926, Mar. 11	13,029,000	73,613,000	86,642,000
1925, Sept. 3	16,215,000	69,424,000	85,639,000
January 1 to date			
1926	350,301,000	642,874,000	993,175,000
1925	355,829,000	493,613,000	849,442,000

Drop in April Steel Output Lighter than in 1925

Compared With Year Ago Lumber Demand Is Heavier While Brick Movement Shows Decrease

A total of 16,564,548 tons of steel ingots were produced in the mills of the United States during the period Jan. 1 to May 1, 1926, as against 15,723,649 tons for the same months last year, according to the American Iron and Steel Institute.

In connection with recent reports of weakness in steel prices, particularly sheets, attention is called to the drop of approximately 7 per cent in ingot output from March to April, this year, compared with a 15 per cent decrease in 1925, as shown by the following figures of calculated monthly production, all companies:

	1926 Tons	1925 Tons
January	4,150,469	4,193,281
February	3,801,776	3,752,352
March	4,488,362	4,194,340
April	4,123,941	3,583,676
Four months	16,564,548	15,723,649

Unfilled orders on books of the U. S. Steel Corporation, Apr. 30, 1926, totaled 3,867,976 tons, against 4,379,935 on Mar. 31 and 4,446,568 on Apr. 30, 1925.

April shipments averaged 6 per cent under the month preceding. Unfilled tonnages on hand as of the last day in each month were as follows:

	1926 Tons	1925 Tons
Jan.	4,882,739	5,037,323
Feb.	4,616,822	5,284,771
Mar.	4,379,935	4,863,564
Apr.	3,867,976	4,446,568

LUMBER DEMAND GAINING

The national softwood lumber movement for the first seventeen weeks of 1926 shows substantial increase over the same period last year, according to the following figures compiled by the National Lumber Manufacturers Association:

	Production M. Ft.	Shipments M. Ft.	Orders M. Ft.
1926	4,307,966	4,517,742	4,532,504
1925	4,060,467	4,182,517	4,062,046

The following table compares the lumber movement as reflected by reports of 367 mills for the week ended May 1, 398 mills for the week ended Apr. 24 and 384 during the week of May 1, 1925:

	Week of May 1, 1926 M. Ft.	Corresponding Week In 1925 M. Ft.	Preceding Week in 1926 M. Ft.
Production	271,890	255,665	283,072
Shipments	285,342	265,016	294,922
New Business	270,913	263,343	266,206

BRICK ORDERS AND SHIPMENTS UNDER YEAR AGO

Aside from a slight rise in the Middle Atlantic states, prices at yards are practically the same as a month ago and about 7 per cent under this time last year.

The quantity of burned and unburned brick stacked at yards is considerably greater this year than last.

The following tabulation shows the movement as reported by the Common Brick Manufacturers' Association of America:

	Burned Brick On Hand M.	Brick Moved from Yards During Month M.	Orders On Books M.
April 1, 1926	339,392	150,485	280,612
March 1, 1926	355,139	110,866	262,481
April 1, 1925	287,800	170,697	329,673

Canadian Materials Prices and Labor Rates Compared

Outlook for Construction Activity Particularly Promising In Western Part of Dominion

A COMPARISON of employment conditions in the various sections of Canada reveals a very favorable outlook for the western part of the Dominion, particularly in construction and agriculture, while factories in the London, Ont., district are operating on a part time basis.

Reports to *Engineering News-Record* from Winnipeg state that business is demonstrating confidence by the investment of millions in industrial plants, and new buildings, necessitating an influx of building trades mechanics.

This report is contrasted with one from London, Ont., to the effect that the locality mentioned, together with Windsor and Kitchener, are experiencing only a fair amount of general employment as many of the industries are not running full time. A good volume of construction, however, is expected, particularly in residences, apartments, public buildings, paving, sewers, and water-works extensions.

Toronto reports considerably more construction under way and in the proposed stage than at this time last year. The bulk of the work consists of factories, schools, apartments, residences and other buildings. Municipal engineering construction appears to be the least active of all the classes of work and very few towns in this district have water-works, sewers or pavement projects in prospect.

The accompanying tables show current construction materials prices and labor rates in various sections of Canada. Prices in the London, Ont., district are governed by those in Toronto while at border points such as Windsor, quotations are necessarily higher owing to conditions prevailing in Detroit. In the Calgary district there is improvement in the outlook for frame building construction, while work in mines is fairly steady.

Building is fairly active in Vancouver, with labor plentiful. Among the major projects about to start or already under way are, a hotel, $1,500,000, a theatre, $1,000,000, and trading posts aggregating $2,500,000. Some additional grain elevators will probably be built this year. Municipal improvement work and road building are in good prospect. Painters are striking for a five-day week; carpenters prepared for a similar move, May 1. A considerable volume of small residential construction is a feature of the present situation.

The outlook for employment of construction labor was never better than at the present time in the Ottawa district. General conditions, according to reports, appear more favorable for the coming season than at any time since 1914. Among the projects pending are several hotels, the largest pulp and paper mill in Canada, also three dams for the International Paper Co. at Chelsea, East Templeton and on the Gatineau River. A $3,000,000 hydro-

(*Continued on p. 794*)

Prices of Construction Materials in Canada

Carload Lots to Contractors, F.O.B., Unless Otherwise Specified

	Ottawa	Calgary	Toronto	Winnipeg	Montreal	Vancouver
Sewer pipe, per ft.						
Diameter						
4-in	$0.35	$0.19	$0.22	$0.35	.....	$0.25
6-in	.55	.26½	.33	.40	.....	.35
8-in	.75	.35	.44	.60	$0.45	.38
12-in	1.45	.63	.82½	1.00	.70	.76
24-in	5.25	2.10	3.30	3.50	1.35	2.90
36-in	.....	.....	....	....	4.50	....
Asphalt, per ton						
Packages	27.45	40.84	27.00	....	28.00	....
Bulk	23.00	35.49	23.00	....	21.00	....
Paving stone, per M						
Granite	.....	4.12 (cu.yd.)	140.00	....	104.75	....
Wood blocks, per sq.yd.						
Size 4, 16 lb. treatment	3.55	2.70	4.25	....	4.50	....
Sand and gravel, per cu.yd.						
1½-in. gravel	1.59	2.50	1.70 (ton)	2.60	1.25	2.10
¾-in. gravel	1.60	3.00	1.85 (ton)	2.60	1.25	2.20
Sand	1.13@1.60	3.00	1.30 (ton)	2.60	1.25	2.10
Crushed stone, per cu.yd.						
1½-in	1.59	2.25	1.80 (ton)	3.00	1.80	2.75
¾-in	1.60	3.00	1.95 (ton)	3.00	1.50	2.75
Cement portland, per bbl. net	2.33	3.48	2.22	3.40	1.80	2.45
Lime, warehouse, including cloth bags, per ton						
Hydrated finishing	22.00	.....	20.50 (del.)	22.40	....	....
Hydrated common	21.00	31.50	19.00 (del.)	....	21.00	24.00
Lump, common	11.00	3.00 (bbl.)	14.60	13.80	10.00	2.65 (bbl.)
Brick, per M.						
Common	20.00@24.00	17.90	23.00	18.00	20.25	24.00
Paving, 3x8½x4	.....	.....	100.00	55.00	100.00	60@70
Hollow tile, per block						
4x12x12	.11	.1143	.07½ (del.)	.073½	.12	.13
8x12x12	.23	.1905	.12½ (del.)	....	....	.24
12x12x12	.33	.2794	.20 (del.)	....	....	....
Lumber, wholesale, per M. ft. b.m.						
Yel. pine, 1x10 in., 16 ft	45.00@60.00	53.50	45.00	46.50	45.00	....
Fir, 1x10 in., 16 ft	55.00@65.00	35.00	45.00	40.50	50.00	20.00
Hemlock, 1x10 in. 16 ft	40.00	35.00	38.00	.....	40.00	21.00
Yel. pine, 2-in. t. and g., 10-in., 16 ft. and under	75.00	65.50	50.00	.....	65.00	.....
Fir, 2-in. t. and g., 10-in., 16 ft. and under	.....	41.50	50.00	.....	50.00	.....
Yel. pine, 8x8 in., 20 ft	.....	.....	55@60	54.00	50.00	.....
Fir, 8x8 in., 20 ft	55.00	41.50	55@60	.....	58.00	21.00
Hemlock, 8x8 in., 20 ft	48.00	41.50	40.00	.....	.....	.....
Spruce, 8x8 in., 20 ft	52.00	.....	40@50	.....	.....	.....
Yel. pine, 12x12, 20 ft	.....	.....	60.00	54.00	60.00	.....
Fir, 12x12 in., 20 ft	58.00@62.00	41.50	60.00	54.00	65.00	21.00
Manila rope, per lb.						
½-in., 1,200-ft. coils	.28	.27	.27	.....	.16	.29½
Explosives, per lb.						
Dynamite, 40 per cent gelatin	.1885	.222	.22 (del.)	.....	.195	.204
Dynamite, 60 per cent gelatin	.....	.244	.24 (del.)	.....	.235	.234

Building Trades Wages and Hours of Labor in the Principal Cities of Canada

	Carpenters	Electrical Workers	Painters	Plasterers	Plumbers	Bricklayers	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Ironworkers	Laborers	Hours per Week
Halifax, N. S.	$0.66	$0.70	$0.66	$0.75	$0.70	$0.75	....	....	....	....	$0.43	44
St. John, N. B.	.60	.50	.75	.80	.65	.80	....	....	....	....	.45	50
Quebec, Que.	.68	.65	.60	.70	.60	.75	....	....	....	....	.45	50
Montreal, Que.	.85	.80	.65	.80	.75	1.00	$0.56½	$0.30@.35	$0.50	$0.80	.25@.30	44
Ottawa, Ont.	.75@.90	.88	.75	.85	.80	1.10	.75	.45	....	.75	.45@.60	44
Toronto, Ont.	.80@.90	.90	.75	1.00	.90	1.12½	.70@.85	.60	.60	.65@.75	.35@.75	44
Hamilton, Ont.	.85	.85	.65	1.00	.90	1.00	....	....	....	....	.60	44
Winnipeg, Man.	.85@1.00	.85	.88	1.13	1.00	1.35	1.00	.45	.45	.95	.40@.55	44
Regina, Sask.	1.00	.90	.88	1.20	1.00	1.25	....	....	....	....	.60	44
Calgary, Alta.	.80@1.00	1.00	.80	1.25	1.00	1.15@1.25	.80	.30@.50	....	.75@.85	.30@.50	44
Edmonton, Alta.	.85	.92	.85	.80	1.00	1.25	....	....	....	....	.60	44
Vancouver, B. C.	.87½@.91	1.00	.88	1.13	1.00	1.13	.87½@1.00	.75	87½	1.12½	.50@.70	44
Victoria, B. C.	.85	1.00	.70	.87	.90	1.00	....	....	....	....	.55	44
Kingston, Ont.	.85	....	.70	1.00	.80	1.00	....	....	....	....	.45	44

Weekly Construction Market

IMPROVEMENT in pine lumber demand, compared with a week ago, is noted throughout Alabama, Ohio, New York and Illinois; slowness still prevails, however, in Florida and Missouri.

Within a radius of 200 miles of New York City the current trend is upward in common brick, 1-in. boards, crushed stone, window glass, hollow tile and cast-iron pipe. Some declines are reported in cement, 1-in. yellow pine flooring, reinforcing bars, gypsum plaster and plaster board.

Firmness with no visible tendency to change characterizes the market in this area on steel pipe, 1-in. fir flooring, two-by-fours, wire nails, roofing materials, sheathing, and paint stuffs, other than linseed oil. In lime, sand, and structural steel shapes, advances are reported in certain localities and declines in others.

Linseed oil is rising throughout the South and West, although quotations are 11.3c. per lb., f.o.b. New York, for 5-bbl. lots as against 11.5c., April 29, 1926.

The price trend is definitely downward in pig iron; buying continues slow. Steel sheets, black and galvanized particularly, show a declining tendency at mills. Considerable firmness is still apparent in the principal hot-rolled products; bars selling at $2 per 100 lb., Pittsburgh, shapes, $1.90@$2 and plates, $1.90, f.o.b. mills. At this time last year bars, plates and shapes were all selling at a mill base of $2 per 100 lb. Sheets, however, were as weak then as they are at the present time.

With the exception of fir timbers, Canadian materials prices have shown firmness during the past two weeks.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb	$3.34	$3.40	$4.15	$3.10	$3.35	$3.07½	$3.30	3.35	+$4.00
Structural rivets, 100 lb	4.50	3.50	4.75	3.50	3.75	4.65	5.00	+4.00	5.50
Reinforcing bars, ¾ in. up, 100 lb	3.24	3.30	3.38	3.00	3.25	3.77½	3.20	3.25	+3.25
Steel pipe, black, 2½ to 6 in. lap, discount	48%	44.3%	53.6%	55%	54.25%	36%	+35.6@49.2%	45%	59.49
Cast-iron pipe, 6 in. and over, ton	+51.60@53.60	46.35	54.00	49.20@50.20	53.00	64.00	52.00	55.00	55.00
Concreting Material									
Cement without bags, bbl	2.50@2.60	2.35	2.05	2.10	2.32	2.85	2.31	2.65	1.42
Gravel, ¾ in., cu.yd	1.75	1.90	2.38	1.60	1.65	1.90	1.80	1.50	+1.50
Sand, cu.yd	1.00	1.60	2.00	1.40	1.25	1.00	1.40	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.85	2.50	2.83	1.87½	1.75	2.50	1.70	3.00	+1.70
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	62.50	34.00	56.00	41.00	+38.75@39.25	34.75	27.00	25.00	—55.00
Lime, finishing, hydrated, ton	18.20	23.50	20.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime, common, lump, per bbl	2.25@2.75	1.50	1.85	2.25	1.35	2.70	1.60	2.80	10.00
Common brick, delivered, 1,000	20.50	10.50	11.10	12.00	14.25	12.00	15.00	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	.0895	.10	.075	.....	.075	.....	—.09	.12
Hollow partition tile 4x12x12, per block	.1112	.0895	.10	.075	.076	.075	.108	—.09	.10
Linseed oil, raw, 5 bbl. lots, gal	— 84¾	+ 92¼	1.13	+ 87	.95¼	+1.07	+.97	1.12	1.10
Common Labor									
Common labor, union, hour	.62½@.75	.30	.....	.87½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.50	.82½	.45@.55	.35@.50	.50	.50	.25@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime in 280-lb. bbl. net and hydrated lime, f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Labor—Concrete laborers' rate, 93¾c.; building laborers, 75c.; excavating laborers, 62½c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone f.o.b.; price on fir is quoted instead of pine.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at plt. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.60 for Sheboygan. Common labor not organized.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of May 6, the next on June 3.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C.-I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on fir lumber. Sand, stone, gravel and lump lime per ton. Stone and tile are delivered; sand, gravel, lime and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 100.14). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3½-in., $59.49.

Canadian Materials Prices

(*Continued from p. 793*)

electric development on the Ottawa River will be started soon by the Ontario Hydro-Electric Power Commission of Toronto. A railway from Amos to Rouyn, P. Q., and a considerable volume of small buildings are contemplated.

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